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EUROPEAN ATOMIC ENERGY COMMUNITY - EURATOM

TABLES OF CROSS-SECTIONS OF NUCLEAR REACTIONS WITH NEUTRONS IN THE 14-15 MeV ENERGY RANGE

by

H. NEUERT and H. POLLEHN

1963

Report established by
the University of Hamburg, Germany
under the Euratom Contract No. 010-62-6 GEE D

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SUMMARY

During the last few years many measurements of nuclear reactions with neutrons (n, $2n$), (n, p), (n, np), (n, d), (n, He^3), (n, t), (n, α) and (n, $n\alpha$) in the energy range E_n = 14-15 MeV have been carried out, so that a compilation of the cross-sections of these reactions seemed to be of general value. Thus, these tables of cross-sections will give a general picture of the measured values available, provide a basis for special theoretical considerations, and in some cases point up the urgency of making further investigations on more precise measurements in this field.

The tables are arranged as follows :

I. Column I will mark each single measurement : the first number gives the atomic number and the second the mass of the target nucleus. The second number is left out if only the cross-section of the natural element has been measured. The small letter marks the type of reaction :

- a — (n, $2n$) reaction
- b — (n, p) reaction
- c — (n, np + n, pn + n, d) reaction
- d — (n, p + n, pn) reaction
- e — (n, np) or (n, nd) reaction
- f — (n, d) or (n, He^3) reaction
- g — (n, p + n, pn + n, np + nd) reaction
- h — (n, t) or (n, $2p$) or (n, tn) reaction
- i — (n, α) reaction
- k — (n, $n\alpha$) reaction

The following number indicates the measurements of the different authors in order of succession.

II. References.

III. Half-life used for the measurement. If the half-life has especially been remeasured, an index mark is given.

IV. Neutron energy in MeV.

V. Cross-section in mb and error.

VI. Specification of the absolute measurement of neutron flux. In the case of relative measurements, the cross-section used for comparison is given.

VII. Description of method.

VIII. Sources of uncertainties which according to the author have been used for calculation of error given in column V.

IX. Target used for experiments.

In many cases not all the details could be specified in the columns because the publications do not contain though all the information necessary for columns III through IX.

It is obvious that two methods were mainly used for the determination of cross-sections :

1) Registration of the particles emitted in the reaction (nuclear plates, telescope) ;

2) Measurement of β- and γ-ray activities of the targets after irradiation by the neutrons.

For comparison of the results of different authors the following items must be observed :

a) Method 1) does not permit of any discrimination between (n, $p\gamma$)- and (n, pn) or between (n, $\alpha\gamma$)- and (n, αn)-reactions.

b) By method 2) the reactions (n, np), (n, pn) and (n, d) cannot be separated.

c) For a determination of cross-sections by method 2) it is necessary to know the intensities and the energies of all the β- and γ-rays emitted from the residual nuclei. For many nuclei the decay scheme is not known precisely. As a result of this, some errors may appear in the calculation of the cross-section from the radioactivities measured. But even by using equal decay schemes considerable differences in the results may still arise according to the method applied (measurement of total β-ray-activity, measurement of definite γ-energies in photopeaks, measurement of the total γ-activity, counting of positron annihilation radiation by coincidences).

d) As in many publications not all the sources of uncertainties were thoroughly examined for a calculation of the errors, a comparison of the errors quoted by different authors can be made with some reserve only (see VIII). If quoted in the publications column V indicates whether the error given is the mean (mostly) or the probable error.

e) Though a large number of results was compiled, it will still be difficult to make more precise statements on the quality of the single measurements. If there are several results available for one reaction at equal neutron energies it can be concluded from the tables which value could be used as an average. In the following we have considered some important reactions frequently used for comparison or relative measurements.

CROSS-SECTIONS OF SOME REACTIONS FREQUENTLY USED FOR COMPARISONS AND RELATIVE MEASUREMENTS

Some reactions frequently used as a basis for relative measurements of cross-sections are given below. The individual results cannot be used without detailed examination to find out the most probable values of the cross-sections. In some cases however values can be found which may within certain limits represent a usable mean cross-section. It will in general and with all respect to the older experiments be reasonable to give more consideration to the never results because the methods have been improved considerably ; the results from nuclear plate and telescope measurements in particular may mostly include higher errors, because of the lower statistics, for instance. It will be easier to carry out the measurements of the induced radioactivity with improving accuracy. Furthermore, the energy dependence of the cross-sections has to be considered if the measurements extend to a larger range of energy (between 12 and 20 MeV, for instance).

1) $Li^6(n, \alpha)\ H^3$

Though careful measurements were carried out early on by Kern (K58 I) we should like to give priority to the values of Ribe (R52), Frye (F54) and Pollehn (P61 II) which concur fairly closely

$$\sigma = 26 \text{ mb at } 14{,}1 \text{ MeV};$$

2) $O^{16}(n, p)\ N^{16}$

As the scattering of the values given for $E_n = 14.5$ MeV is relatively low, a mean value of $\sigma = 40$ mb is proposed;

3) $Al^{27}(n, p)\ Mg^{27}$

At the energy $E_n = 14.1$ MeV nearly all values join to give

$$\sigma = 81 \text{ mg.}$$

The values for $E_n = 14.8$ MeV are more scattered, but they all come from relative measurements;

4) $Al^{27}(n, \alpha)\ Na^{24}$

It is important to remember that the cross-sections of this reaction slowly decrease from 14 to 15 MeV. For $E_n = 14.1$ MeV the values accumulate to

$$\sigma = 121 \text{ mb,}$$

though recent results by Prestwood (P61 I; P61 IV) gave a value which is 6 mb higher. At 14.8 MeV the results of different authors meet at 114 mb;

5) $Fe^{56}(n, p)\ Mn^{56}$

In this case the results at 14 to 15 MeV are widely scattered, so that it will be necessary to consider further measurements. Averaging several results yields a value of

$$\sigma = 114 \text{ mb at } 14.3 \text{ MeV};$$

6) $Cu^{63}(n, 2n)\ Cu^{62}$.

Although this reaction is frequently used for comparison, the different results are astonishingly far from uniform. A mean value is about

$$\sigma \approx 500 \text{ mb at } E_n = 14.1 \text{ MeV};$$

7) $Cu^{65}(n, 2n)\ Cu^{14}$

Only a scarce number of absolute measurements is available. A mean value of about $\sigma \approx 930$ mb is not yet sufficiently reliable.

On the basis of the more recent experiments by Prestwood (P61 I; P61 IV) on $Al^{27}(n, \alpha)$, this value should be lower about 20 mb.

From all reactions considered here the values of $Al^{27}(n, \alpha)$ appear most accurate (about $\pm 3\%$); for the other reactions deviations of 5 to 8 % from the values suggested here should be allowed.

I	II	III	IV	V	VI	VII	VIII	IX

DEUTERIUM

$D^2(n, 2n) H^1$

I	II	III	IV	V	VI	VII	VIII	IX
1-2*a*1	A58 II	—	14.1	200 ± 20	abs.: α-from T(*d*,*n*) He^4	Pulsed neutron source of 2.5 μsec duration. Detection of double pulses in a cadmium loaded liquid scintillator of 40″ length and 40″ ⌀. The targets were in a hole of the scintillator	Standard deviation contains: stat.(~8%), calibr. (3.4 %), neutron flux (4 %)	Several thin discs CD_2
1-2*a*2	H60	—	—	190 ± 19	—	—	—	—

I	II	III	IV	V	VI	VII	VIII	IX

LITHIUM

$Li^6(n, p)$

I	II	III	IV	V	VI	VII	VIII	IX
3-6*b*1	B53 I		14.1	6.7 ± 0.8	abs.: α-from $T(d, n)He^4$	β-activity, 2π geometry prop. - counter. Calibration by the Cu^{62} activity from $Cu^{63}(n, 2n)Cu^{62}$ with $\sigma Cu^{63}(n, 2n) = 350$ mb at 14.1 MeV (cf. 29-63*a*). Decrease of the activity was recorded with a time-analyser	Standard deviation contains: statistics, calibration, σCu^{63} $(n, 2n)$, neutron flux	Isotopically enriched Li-foils: Li^6(90.94%) 420 mg/cm²; Li^7 (99.90 %) 510 mg/cm²
3-6*b*2 diff.	F54	—	14	6 ± 2 $d\Omega = 4\pi$	abs.: α-from $T(d, n)He^4$	Nuclear plate	Deviation contains: statistics neutron flux (4 %) geometry (1.55 %) separation of particle groups (<7%)	Isotop. enriched Li foils Li^6 (90.9 %) Li^7 (99.9 %) thickness <10 mg/cm²

$Li^6(n, d)He^5$

I	II	III	IV	V	VI	VII	VIII	IX
3-6*e*1 diff.	F54	—	14	89 ± 10 $d\Omega = 0°—169°$		cf. 3-6*b*2		

$Li^6(n, d)He^{5m}$

I	II	III	IV	V	VI	VII	VIII	IX
3-6*e*1*m*	F54	—	14	77 ± 9 $d\Omega = 0°—169°$		cf. 3-6*b*2		

$Li^6(n, t)He^4$

I	II	III	IV	V	VI	VII	VIII	IX
3-6*h*1	R52	—	14.2	26 ± 3.6	—	Li^6 in prop. - counter. Energy spectrum was recorded with a multichannel analyser	—	With Li^6 enriched Li-foil
3-6*h*2 diff.	F54	—	14	26 ± 4 $d\Omega = 4\pi$		cf. 3-6*b*2		

I	II	III	IV	V	VI	VII	VIII	IX
3-6*h*3	R56 I	—	14.1 ± 0.08	26 ± 4	abs.: α-from T(*d*, *n*) He^4	cf. 3-6*h*1	Mean total error	cf. 3-6*b*2
3-6*h*4	K58 I	—	14.0*1 ± 0.2—0.3	28.5 ± 1.6	abs.: α-from D(*d*, *n*) He^4	Direct counting of the H^3 and He^4 in a $Li^6I(E_n)$ - crystal of 1.5″ diameter and 0.5″ height	Mean total error	Li^6I-crystal 96.1 % Li^6
			14.2 ± 0.2—0.3	28.1 ± 1.6				
			14.5 ± 0.2—0.3	27 ± 1.5				
			15 ± 0.2—0.3	26.5 ± 1.5				
3-6*h*5	P61 II	—	14.1 ± 0.15*2	25.8 ± 1.5	abs.: α-from T(*d*, *n*) He^4	α+H^3 from Li^6(*n*, *t*) He^4 were measured in coincidence with α from T(*d*, *n*) He^4; α from D(*d*, *n*) He^4 with a prop. counter and α+H^3 from Li^6(*n*, *t*) He^4 with a $Li^6I(Eu)$ crystal. The Li^6I-crystal served as target and counter	Mean total error	Li^6I-crystal 96 % Li^6 1″ σ 1″ hight

$Li^6(n, dn) He^4$

I	II	III	IV	V	VI	VII	VIII	IX
3-6*j*1 diff.	R56 III	—	14*3	300 ± 50	cf. 3-7*h*2			

$Li^7(n, d) He^6$

I	II	III	IV	V	VI	VII	VIII	IX
3-7*e*1	B53 I	0.83 ± 0.03*4 sec.	14.1	9.8 ± 0.98		cf. 3-6*b*1		

*1 Also measured for 12,5 MeV $\leq E_n \leq$ 18,3 MeV
*2 Also measured for E_n = 2,6 MeV
*3 Also measured for 4.4 MeV $\leq E_n \leq$ 14 MeV
*4 Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
				$Li^7(n, t)\,He^5$				
3-7*h*1 diff.	F54	—	14	55 ± 8 $d\Omega \leqq 0^\circ$—169°		cf. 3-6*b*2		
				$Li^7(n, tn)\,He^4$				
3-7*h*2 diff.	R56 III	—	14*[1]	300 ± 40	abs. : proton recoils in normal emulsions	Nuclear plates with Li-loaded emulsions	—	Element

*[1] Also measured for 4.4 MeV $\leqq E_n \leqq$ 14 MeV

I	II	III	IV	V	VI	VII	VIII	IX

BERYLLIUM

$Be^9(n, 2n) Be^8$

I	II	III	IV	V	VI	VII	VIII	IX
4-9*a*1	A58 II	—	14.1	540 ± 40		cf. 1-2*a*1		
4-9*a*2 diff.	R57	—	14.1	420 ± 70 En>0.5 MeV $d\Omega = 4\pi$	abs. α-from T(*d*, *n*) He^4	Nuclear plate; plates arranged cyl. around a cyl. target. Only the recoil protons were recorded	Estimated total error	Element, cylinder
4-9*a*3	H60	—	—	520 ± 40	—	—	—	—
4-9*a*4 diff.	M61 III	—	14.1	*a*) 540 ± 70	—	*a*) Be-powder mixed with the emulsion of a nuclear plate	—	Powder 20 mg/cm³
				b) $4\pi\left[\frac{d\sigma}{d\Omega}\right] = 480 \pm 9$ means for $\theta = 0°$, 20°, 45°, 65°, 90°, 105°, 120°		*b*) Metallic Be cyl. surrounded by several plates		Metallic Be

$Be^9(n, \alpha) He^6$

I	II	III	IV	V	VI	VII	VIII	IX
4-9*i*1	B53I	0.83 ± 0.03*	14.1	10 ± 1		cf. 3-6*b*1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

BORON

$B^{10}(n, dn')\ 2He^4$

I	II	III	IV	V	VI	VII	VIII	IX
5-10*e*1 diff.	F-56	—	14.1*[1]	128 ± 19	—	Nuclear plate with B^{10} loaded emulsion	—	—

$B^{10}(n, t)\ 2He^4$

I	II	III	IV	V	VI	VII	VIII	IX
5-10*h*1	F-56	—	14.1*[1]	102 ± 17	—	cf. 5-10e_1	—	—

$B^{11}(n, p)\ Be^{11}$

I	II	III	IV	V	VI	VII	VIII	IX
5-11*b*1	K-61I	—	14.5 ± 0.8	3.2 ± 0.4	rel. : cf. 29-63a_3 Cu^{63} $(n, 2n)$ = 556*mb*		cf. 13-27*b*4	Powder thin target
5-11*b*2	K-62	13.6 sec	14.8 ± 0.4	3.3 ± 0.6	rel. : cf. 29-33*a* $Cu^{63}(n, 2n)$ = 507 mb	*a*) β-activity 2π geometry (corrections cf. 13-27i_4) *b*) γ-activity, measuring of the area under the photo-peak with a 3″ × 3″ NaI crystal	Probable total error	Powder thin target

$B^{11}(n, \alpha)\ Li^8$

I	II	III	IV	V	VI	VII	VIII	IX
5-11*i*1 diff.	A56	—	14.7 ± 0.68*[2]	30.9 ± 6.3	abs. : α-from $T(d, n)\ He^4$	Nuclear plate with B^{11} loaded emulsion	Total error	B^{11}-powder
5-11*i*2	H54	0.88 sec	14	∼30	—	BF_3-counter. Measuring of the α from Be^8 after the β-decay of Li^8	—	—

*[1] Also measured for 6 MeV $\leq E_n \leq$ 20 MeV
*[2] Also measured for 12,6 MeV $\leq E_n \leq$ 20 MeV

CARBON

$C^{12}(n, 2n)\, C^{11}$

I	II	III	IV	V	VI	VII	VIII	IX
6-12*a*1	B61 II			Only rel. measurement of the excitation function[*1]				
6-12*a*2	B52			cf. 29-63*a*4 [*4]				

$C^{nat}(n, 2n)$

I	II	III	IV	V	VI	VII	VIII	IX
6- *a*2	A58 II	—	14.1	6 ± 6	cf. 1-2*a*1			

$C^{12}(n, p)\, B^{12}$

I	II	III	IV	V	VI	VII	VIII	IX
6-12*b*1	K59 I	18.87 ± 0.50[*2] msec	14.92 ± 0.48[*3]	1.93 ± 0.25	rel. : cf. 3-6*h*4 $Li^6(n, t) = 26.5$ mb for $E_n = 15$ MeV	Pulsed neutron source, 7 pulses/sec ; 1 msec duration. Counting between pulses. The pulse height distribution was recorded with a 100 channel and the total counts with a 9 channel time analyser	Total error	Plastic - scintillator served as a carbon containing target and permitted counting the β as a 4π counter

[*1] Measured from threshold to 37 MeV
[*2] Measured by the authors
[*3] Also measured for 14.92 MeV $\leq E_n \leq$ 17.5 MeV
[*4] Measured from threshold to 27 MeV

I	II	III	IV	V	VI	VII	VIII	IX

NITROGEN

$N^{14}(n, 2n) N^{13}$

I	II	III	IV	V	VI	VII	VIII	IX
7-14*a*1	P53	9-9 min	14.5 ± 0.35	5.67 ± 0.85	abs. : α-from T(*d*, *n*) He^4	β-activity. prop. counter. Calibration with standard sources	Standard deviation, no systematic errors	Sugar, cylinder 3 cm ⌀ max. height 1,27 cm, but always more than half max. range of the β
7-14*a*2	R58 II	12.3 min	14	~8.5	ref. : cf. 29-63*a* $Cu^{63}(n, 2n)$ = 500 mb	β^+ activity 0.511 MeV annihilation radiation measured in coincidence with 2 scintillation counters (NaI crystals)	—	—
7-14*a*3	F-60*	—	13.77 ± 0.20 14.74 ± 0.27	5.18 ± 0.6 8.69 ± 0.9	rel. : cf. 3-6*h*4 $Li^6(n, t) He^4$ = 28.1 mb Leaky-integrator used	β^+ activity. 0,511 MeV annihilation radiation measured in coincidence with 2NaI crystals. Calibration with Na^{22}	Error contains : $\sigma Li^6(n, t)$ - 5 %, $\frac{d\sigma}{d\Omega}$ $H^3(d, n)$ - 4 %, leaky integr. - 2 %, cal.- 5 %, stat. 1-15 % target position 2 %	$N_6 C_3 H_6$, cylinder 7/16″ ⌀, 1″ height
7-14*a*4	B61 I	—	14.1	4 ± 1.2	—	β activity and γ activity	Estimated total error	NH_4NO_3
7-14*a*5	A58 II	—	14.1	19 ± 10		cf. 1-2*a*1		Melamine cf. 1-2*a*1
7-14*a*6	D54	10 min	14	3.4 ± 1	abs. : α-from T(*d*, *n*) He^4	β^+ activity 0,511 MeV annihilation radiation measured in coincidence, counting-system calibrated with Na^{22}	—	Liquid nitrogen
7-14*a*7	R61 II	12.3 ± 0.65 min	14.4 ± 0.3	7.41 ± 0.58	rel. : cf. 29-63*a* $Cu^{63}(n, 2n)$ = 503 mb	β^+ activity 0,511 MeV annihilation radiation measured in coincidence with 2NaI crystals. Calibration with Cu^{62}	Mean total error	NaN_3, variable thickness, 1 cm ⌀

* Also measured for 12.4 MeV $\leq E_n \leq$ 18 MeV

I	II	III	IV	V	VI	VII	VIII	IX
7-14*a*8	B61 II			cf 6-12*a*1*				

$N^{14}(n, \alpha)\, B^{11}$

I	II	III	IV	V	VI	VII	VIII	IX
7-14*i*1	L52	—	14.1	~100	rel. : cf. A50 σn-p scattering = 675 mb	In a cloud-chamber N^{14} and H^1 in a known ratio	—	Gas

* Also measured from threshold to 37 MeV

OXYGEN

$O^{16}(n, 2n)\,O^{15}$

I	II	III	IV	V	VI	VII	VIII	IX
8-16*a*1	B61 II			cf. 6-12*a*1*[1]				

$O^{16}(n, p)\,N^{16}$

I	II	III	IV	V	VI	VII	VIII	IX
8-16*b*1	P53	7.3 sec	14.5 ± 0.35	49 ± 25		cf. 7-14*a*1		
8-16*b*2	L52	—	14.1	35		cf. 7-14*i*1	for $N^{14} \to O^{16}$	
8-16*b*3	M54	7.38 ± 0.05*[2]	14*[3]	89 ± 27	rel.: cf. 29-63*a*2 $Cu^{63}(n, 2n)$ = 510 mb	Stilben; 4 cm ⌀ ½ mm height. The counting efficiency for the β of Cu^{62} was supposed to be the same as for the β of N^{16}	Estimated total error	5 gr. H_2O
8-16*b*4	K61 I	7 sec	14.5 ± 0.8	39 ± 3.9		cf. 5-11*b*1		Powder
8-16*b*5	D60 I	7.352 ± 0.009 sec cf. E59I	14.7 ± 0.1	39.2 ± 1.6	abs. proton recoil telescope	β-activity, 4π counter. Liquid-scintillator served as target and counter. Counting efficiency proved with Tl^{204}(99.5 %). Activity measured with 2 multipliers switched in coincidence; γ-spectrum recorded with a calibrated NaI-crystal	Total error	Liquid-scintillator: Dioxane (383 gr.) Naphthalene (37.5 gr.), PPO (37.5 gr.), POPOP (0.010 gr.)
8-16*b*6	S61 I	7.35 sec.	14.4	34 ± 6	abs.: proton recoil telescope	β-activity, liquid-scintillator served as target and counter	—	Liquid-scintillator
8-16*b*7	K62	7.4 sec	14.8 ± 0.4	38.2 ± 5	rel.: cf. 29-63*a* $Cu^{63}(n, 2n)$ = 507 mb	cf. 5-11*b*2		

*[1] Measured from threshold to 37 MeV
*[2] Measured by the authors
*[3] Measured also for 12 MeV $\leqq E_n \leqq$ 18 MeV

I	II	III	IV	V	VI	VII	VIII	IX
					$O^{16}(n, d) N^{15}$			
8-16*f*1	L52	—	14.1	~15		cf. 7-14*i*1		
					$O^{16}(n, \alpha) C^{13}$			
8-16*i*1	L52	—	14.1	~310		cf. 7-14*i*1		

FLUORINE

$F^{19}(n, 2n) F^{18}$

I	II	III	IV	V	VI	VII	VIII	IX
9-19*a*1	P53	1.8*h*	14.5 ± 0.35	60.6 ± 8		cf. 7-14*a*1		CaF_2, NaF cf. 7-14*a*1
9-19*a*2	R58 I	1.85*h*	14	51.3		cf. 7-14*a*2		
9-19*a*3	B61 I	—	14.1	50 ± 15		cf. 7-14*a*4		CF_2
9-19*a*4	A58 II	—	14.1	62 ± 8.7		cf. 1-2*a*1		CF_2
9-19*a*5	R61 II	1.85 ± 0.04*[1]	14.4 ± 0.3	51.9 ± 3.8		cf. 7-14*a*7		CF_2
9-19*a*6	B61 II		cf 6-12*a*1*[2]					

$F^{19}(n, p) O^{19}$

I	II	III	IV	V	VI	VII	VIII	IX
9-19*b*1	P53	30 sec	14.5 ± 0.35	135 ± 47		cf. 7-14*a*1		CaF_2, NaF cf. 7-14*a*1
9-19*b*2	K61 I	—	14.5 ± 0.8	16.5 ± 2	rel. : cf. 13-27*b*5 $Al^{27}(n, p)$ = 87 ± 8 mb	cf. 5-11*b*1		AlF_3, CF_2
9-19*b*3	K62	29 sec	14.8 ± 0.4	14.3 ± 3.5		cf. 5-11*b*2		

$F^{19}(n, \alpha) N^{16}$

I	II	III	IV	V	VI	VII	VIII	IX
9-19*i*1	K61 I	—	14.5 ± 0.8	57 ± 7		cf. 5-11*b*2		AlF_3-powder CF_2, thin target

*[1] Measured by the authors
*[2] Also measured from threshold to 37 MeV

I	II	III	IV	V	VI	VII	VIII	IX

SODIUM

$Na^{23}(n, 2n)\ Na^{22}$

I	II	III	IV	V	VI	VII	VIII	IX
11-23*a*1	P55	2.6*y*	14.1 ± 0.2	13.8 ± 2.2	rel. : $Al^{27}(n, \alpha)$ = ? Sandwich-method	β-activity ; 4π prop. counter calibrated with Na^{22}. Chemical separation	2x mean deviation from 6 measurements	NaF ; after chem. separation NaCl (30-80 mg)

$Na^{23}(n, p)\ Ne^{23}$

I	II	III	IV	V	VI	VII	VIII	IX
11-23*b*1	P53	40 sec	14.5 ± 0.35	33.9 ± 15		cf. 7-14*a*1		NaCl
11-23*b*2	B60	40 sec	14.1 ± 0.1	9 ± 4	rel. : cf. 53-127*a* $I^{127}(n, 2n)$ = 1200 mb	β-activity, NaI crystal served as target and counter	Stat. error	NaI crystal
11-23*b*3	M61 II	—	14.8	29 ± 2.9		cf. 11-23*i*2		
11-23*b*4	W61 II	37.6 sec	No measurements for* 14 MeV ≤ E_n ≤ 15 MeV		abs. : proton-recoil-spectrometer. Leaky integrator	β-activity, 1½″ × 1½″ NaI crystal served as target and counter	—	NaI crystal

$Na^{23}(n, p)\ Ne^{23} + Na^{23}(n, pn)\ Ne^{22}$

I	II	III	IV	V	VI	VII	VIII	IX
11-23*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^0}$ = *a*) 57 ± 20 *b*) 50 ± 20	rel. : cf. 26—54*d*3 $Fe^{54}(n, p)$ = 395*mb*	Shielded nuclear plate surrounded by several targets arranged in a circle of 8 cm∅. Only protons with 0~120° counted. Separation of *n,p*- and *n,np*-processes by stat. theory with level densities : *a*) $\rho \sim \exp(-\varepsilon/T)$ *b*) $\rho \sim \exp 2(aU)^{1/2}$ Probably the cross-sections contain *n,d*-processes	Deviation contains : stat. error ; separation of *n,p*- and *n,np*-processes	6 targets of 2 × 1 cm and 6-40 mg/cm² thickness

* Measured for 4 MeV ≤ E_n ≤ 19 MeV

I	II	III	IV	V	VI	VII	VIII	IX
					$Na^{23}(n, \alpha) F^{20}$			
11-23*i*1	B60	12 sec.	14.1 ± 0.1	29 ± 10	rel. : cf. 53-127*a* $I^{127}(n, 2n) = 1200 mb$	β-activity NaI-crystal served as target and 4π counter	Stat. error	NaI-crystal
11-23*i*2	M61 II	—	14.8	222 ± 22	rel. : cf. 29-63*a*3 $Cu^{63}(n, 2n) = 556 mb$ Sandwich-method	β-activity 2π geometry, prop. counter. Calibration with standard sources	Mean deviation of the single experimental points	Powder or foils
11-23*i*3	W61 II	10.7 sec.	No measurements for* 14 MeV $\leq E_n \leq$ 15 MeV		cf. 11-23*b*4			

* Measured for 4 MeV $\leq E_n \leq$ 19 MeV

MAGNESIUM

$Mg^{24}(n, p)\,Na^{24}$

I	II	III	IV	V	VI	VII	VIII	IX
12-24*b*1	P53	15*h*	14.5 ± 0.35	191 ± 35		cf. 7-14*a*1		Element
12-24*b*2	D60 II	—	15 ± 0.4	203 ± 11		cf. 26-56*b*1		
12-24*b*3	B61 V	—	14	190 ± 10	rel. : cf. 16-32*b*2 $S^{32}(n, p) = 254 mb$	Activation method	—	—
12-24*b*4	K59 III	—	13.03 ± 0.2	219 ± 26		cf. 14-28*b*2		
12-24*b*5	C56	12*h*		β-activity measured with 3 uncalibrated geiger-counters. The excitation curves were fitted at 14.5 MeV with the cross-section for the same reaction found by P53*¹				
12-24*b*6	I61	—	14.00*² 14.10 14.50 14.90	198 ± 30 200 ± 30 180 ± 27 173 ± 24	—	γ-activity measured with a 4″ diameter by 4″ long NaI crystal	Uncertainties primarily involve : neutron flux calibration of the NaI crystal	—
12-24*b*7	G61 IV	—	14.00*³ 14.50 14.90 15.00	185 ± 15 174 ± 14 170 ± 12 170 ± 12	—	—	—	—

$Mg^{24}(n, p)\,Na^{24} + Mg^{24}\,(n, pn)\,Na^{23}$

I	II	III	IV	V	VI	VII	VIII	IX
12-24*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^o} =$ *a*) 118 ± 16 *b*) 110 ± 16		cf. 11-23*d*1		
12-24*d*2 diff.	C60 I	—	14.5	$4\pi\left[\frac{d\sigma}{d\theta}\right] = 285 \pm 20$ means for $\theta = 62^o$, 75^o, 95^o, 138^o, 162^o and $d\theta = 10^o$		cf. 16-32*d*2		

*¹ Measured for 12.5 MeV $\leq E_n \leq$ 17.5 MeV
*² Also measured for 12.00 MeV $\leq E_n \leq$ 19.50 MeV
*³ Also measured for 12.6 MeV $\leq E_n \leq$ 17.1 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Mg^{24}(n, p)\ Na^{24m}$				
12-24*b*1*m*	G59 I	20 msec*	14.5	80 ± ~36—40	rel. : cf. 29-63*a* $Cu^{63}(n, 2n) = 500mb$	Pulsed neutron source, 1 pulse/sec. 1.3 msec duration : γ-activity measured between pulses with an experimentally calibrated NaI crystal. *a*) Total spectrum was recorded with a multichannel pulse height analyser *b*) Decrease of the photopeak was measured with a time-analyser (Channel width $0.1\text{-}4.10^{-5}$ sec)	Estimated total error	Thick target ; 4.5 or 10 cm ∅
				$Mg^{25}(n, p)\ Na^{25}$				
12-25*b*1	P53	60 sec	14.5 ± 0.35	44.9 ± 18		cf. 7-14*a*1		Element
12-25*b*2	N58	60 sec	14.8 ± 0.8	60 ± 10	rel. : cf. 8-16*b*3 $O^{16}(n, p) = 89mb$	cf. 12-26*b*1		
				$Mg^{25}(n, p)\ Na^{25} + Mg^{25}(n, p)\ Na^{24}$				
12-25*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega}\right]_{120^0} =$ *a*) 67 ± 10 *b*) 63 ± 10		cf. 11-23*d*1		
				$Mg^{26}(n, p)\ Na^{26}$				
12-26*b*1	N58	1.04 ± 0.03 sec*	14.8 ± 0.8	50 ± 5	rel. : cf. 8-16*b*3 $O^{16}(n, p) = 89mb$	β-activity counted with a plastic-scintillator	—	MgO, natural and enriched $Mg^{26}O \neq 99\%$ cylinder 1-6 cm ∅, 2-3 cm height

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
				$Mg^{26}(n, p)\,Na^{26} + Mg^{26}(n, pn)\,Na^{25}$				
12-26*d*1	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^0} =$ a) 27 ± 7 b) 27 ± 7		cf. 11-23*d*1		
				$Mg^{26}(n, \alpha)\,Ne^{23}$				
12-26*i*1	N58	38.0 ± 0.3 sec*	14.8 ± 0.8	89 ± 5		cf. 12-26*b*1		
				$Mg^{nat}(n, p + n, pn + n, np + n, d)\,Na$				
12-g1 diff.	V57	—	14	$4\pi \left[\frac{d\sigma}{d0}\right] = 32 \pm 3.8$ means for $0 = 30^o$, 45^o, 60^o, 90^o, 120^o, 135^o, 150^o and $E_p <$ 6 MeV	abs. : α-from $T(d, n)\,He^4$	Shielded CsI crystal in coincidence with α from $T(d, n)\,\alpha$. σ probably contains (n, α) processes	—	Height : 2.5 MeV energy loss for 6 MeV protons ; calibration with a polyetylene foil
				$Mg^{nat}(n, p + n, pn)\,Na$				
12-*d*1 diff.	H62 III	—	14.4 ± 0.2	88 ± 9 means for $0 = 0^o \rightarrow 150^o$ in 30^o intervals and $E_p >$ 3 MeV	abs. : neutron flux monitored by a BF_3 counter calibrated with a Ra-Be source and the *n*,*p*-scattering	Telescope with 3 prop. counters and a CsI-crystal. Separation of *n*,*p*- and *n*,*np*-processes by stat. theory	—	—

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

ALUMINUM

$Al^{27}(n, 2n) Al^{26m}$

I	II	III	IV	V	VI	VII	VIII	IX
13-27*a*1*m*	M60			cf. 13-27*b*6*[1]				

$Al^{27}(n, p) Mg^{27}$

I	II	III	IV	V	VI	VII	VIII	IX
13-27*b*1	P53	10 min	14.5 ± 0.35	52.4 ± 14		cf. 7-14*a*1		
13-27*b*2	F52	9.6 min	14.1	79 ± 5.5	abs.: α from T(*d*, *n*) He[4]	β-activity. 2 prop. counters 4 different geometries (4.5% : 13% : 23% : 45%): counters and geometries calibrated with standard sources. Scattering and absorption in the targets determined by measurements with targets of different thickness; extrapolation to thickness 0	Total error without uncertainties in the decay-scheme	Element, ½″ ∅. Purity > 99 %
13-27*b*3	Y57	9.8 min	14.1 ± 0.15	82.2 ± 6.6	abs.: α-from T(*d*,*n*) He[4] with ZnS counter	β-activity, 2π and 4π geometry. Corrections for absolute β counting were determinated *a*) by measurements in 2π and 4π geometry *b*) by measurements with targets of different thickness: extrapolation to thickness 0	Total error without systematic deviations	—
13-27*b*4	P59 I	9.46 ± 0.02 min*[2]	14.8 ± 0.8	53 ± 5	rel.: cf. 29-63*a*3 $Cu^{63}(n, 2n)$ = 556 mb Sandwich method	β-activity, 2π geometry prop. counter. Corrections for absolute β-counting computed (cf. N52: B53 III; G51: B49; Z50; J50; W53; C57 I)	Maximal deviations of the single experimental points from the means	Element: discs 1.7-2.1 cm ∅ thickness 3 mg/cm²

*[1] Measured from threshold to 21 MeV
*[2] Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
13-27*b*5	K61 I	—	14.5 ± 0.8	87 ± 8	rel. : cf. 29-63*a*3 $Cu^{63}(n, 2n)$ = 556 mb Sandwich method	cf. 27-59*b*1		Element and Al_2O_3: thin target
13-27*b*6	M60	—	Rel. measurement. Excitation curve fitted at 14.1 MeV *¹			γ-activity : NaI crystal of 2.54 cm height and 3.81 cm ∅. γ-spectrum was recorded with a multi-channel-analyser	Rel. error: no systematic deviations	Element: cylinder 2.5 cm height 5.08 cm ∅
13-27*b*7	K59 II	9.5 min	14.3 ± 0.5	115.5 ± 10	rel. : cf. 26-56*b* $Fe^{56}(n, p)$ = 110 mb Sandwich method	β-activity, prop. counter with a window of 4.5 mg/cm^2	Stat. error. Other deviations ∼10 %	Powder 20 mg/cm^2 in tape of 9 mg/cm^2. Purity > 99.9 %
13-27*b*8	P61 III	9.6 ± 0.3 min*²	14.1 ± 0.1	80.8 ± 4.5	rel. : cf. 3-6*h*5 $Li^6(n, t)$ = 25.8 mb	γ-activity NaI- well-crystal of 3″ ∅ and 2″ height, and a hole of 1″ ∅ and 1″ depth. Decrease of the total spectrum and of single γ-lines recorded. Corrections for abs. γ-counting anal. computed (cf. P61 VII). Decay-scheme : cf. S58	Standard total error	Element, powder in a plexiglass-cyl. of 1″ ∅ and 1″ height
13-27*b*9	M61 II	—	14.8	77 ± 7.7	rel. : cf. 29-63*a*3 $Cu^{63}(n, 2n)$ = 556 mb or cf. 13-27*i*8 $Al^{27}(n, \alpha)$ = 117 mb Sandwich method	β-activity, 2π geometry prop.-counter. Corrections for abs. β-counting computed and experim. determinated by standard sources	Mean deviation of the experim. points	Powder or foils
13-27*b*10	D60 II	—	15 ± 0.4	59 ± 6		cf. 26-56*b*7		
13-27*b*11	H59	—	14.8	80.8 ± 10	—	γ-activity, NaI crystal	—	—

*¹ Also measured for 12 MeV $\leq E_n \leq$ 21 MeV
*² Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
13-27*b*12	S61 II	10.00 ± 0.03 min*[1]	14.1 ± 0.2	85 ± 2.8	abs.: α-from T(*d*, *n*) He^4	β-activity, block of sandwiched targets: plastic- and target- foils served as counter and target. Calibration by standard sources	Stat. deviation	Foils
13-27*b*13	K62	9.5 min	14.8 ± 0.4	82 ± 10		cf. 5-11*b*2		
13-27*b*14	G61 IV	—	14.35 ± 0.1*[2] 14.4 14.9 ± 0.2	52 ± 3 57 ± 4 56.5 ± 3	—	—	—	—

$Al^{27}(n, p)\,Mg^{27} + Al^{27}(n, pn)\,Mg^{26}$

I	II	III	IV	V	VI	VII	VIII	IX
13-27*d*1	A57 II	—	14.1	70 ± 14	abs.: α-from T(*d*, *n*) He^4	Nuclear plate, separation of *n*, *p*- and *n*,*np*-processes by stat. theory. σ probably contains *n*,*d*-processes	Estimated total error	Isotopically enriched targets; thickness 5-12 mg/cm²
13-27*d*2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^0} =$ *a*) 87 ± 11 *b*) 76 ± 10		cf. 11-23*d*1		
13-27*d*3 diff.	S60	—	14.1	$2\frac{d\sigma}{d\Omega} = 90 \pm 18$ for $d\Omega = 0^o$—180^o	abs.: proton recoil spectrometer	Direct measurement of the protons by a shielded CsI crystal. Approximately 2π geometry. Distance from target to crystal = 2 mm. Separation of *n*,*p*- and *n*,*np*-processes by stat. theory. Probably σ contains *n*, *d*-processes	Estimated total error	Isotopically enriched targets; thickness ~15 mg/cm²

*[1] Measured by the authors
*[2] Also measured for $13.2\ MeV \leq E_n \leq 17.8\ MeV$

I	II	III	IV	V	VI	VII	VIII	IX
13-27*d*4 diff.	G61 III	—	14.8 ± 0.8	$4\pi\left[\frac{d\sigma}{d\theta}\right] =$ *a*) 89 ± 8 for the isotr. part *b*) 116 ± 10 for the total part, means for 10 angles between 0° and 150°		cf. 28-58*d*4		Foils, thickness 7.1 mg/cm²
13-27*d*5 diff.	H62 III	—	14.4 ± 0.2	93 ± 10 for $E_p > 2.8$ MeV $Al^{27}(n, np) Mg^{26}$		cf. 12-*g*1		

$Al^{27}(n, np)\ Mg^{26}$

I	II	III	IV	V	VI	VII	VIII	IX
13-27*e*1	A57 III	—	14.1	70 ± 14		cf. 13-27*d*1		
13-27*e*2 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^0} = 53 \pm 11$		cf. 11-23*b*4		
13-27*e*3 diff.	H62 III	—	14.4 ± 0.2	17 ± 6 for $E_p > 2.8$ MeV		cf. 12-*g*1		
13-27*e*4 diff.	G61 III	—	14.8 ± 0.8	$4\pi\left[\frac{d\sigma}{d\theta}\right] = 157 \pm 15$ means for 10 angles between 0° and 150°		cf. 28-58*d*4		

$Al^{27}(n, p)\ Mg^{27} + Al^{27}(n, pn + n, np + n, d)\ Mg^{26}$

I	II	III	IV	V	VI	VII	VIII	IX
13-27*g*1 diff.	V57	—	14	$4\pi\left[\frac{d\sigma}{d\theta}\right] = 34 \pm 6$ means for θ = 30°, 45°, 60°, 90°, 120°, 135°, 150° and $E_p > 6$ MeV		cf. 12-*g*1		
13-27*g*2 diff.	H57	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right] = 79 \pm 16$ means for θ = 30°, 60°, 90°, 120°, 150° and *d*θ = 15°	abs. : recoil-protons in a nuclear plate	Nuclear plates cyl. arranged around the target	Estimated total error	Al-foils ; thickness 7.1 mg/cm²

I	II	III	IV	V	VI	VII	VIII	IX
				$Al^{27}(n, t)\,Na^{23}$				
13-27*h*1	P62	—	14.7	< 0.02	—	—	—	—
				$Al^{27}(n, \alpha)\,Na^{24}$				
13-27*i*1	P53	15*h*	14.5 ± 0.35	78.9 ± 16		cf. 7-14*a*1		
13-27*i*2	F52	15*h*	14.1	135 ± 9.5		cf. 13-27*b*2		
13-27*i*3	Y57	15.1*h*	14.1 ± 0.15	120 ± 14		cf. 13-27*b*3		
13-27*i*4	P59 I	15.00 ± 0.06*h**1	14.8 ± 0.8	114 ± 7		cf. 13-27*b*4		
13-27*i*5	M60	—		cf. 13-27*b*6*2				
13-27*i*6	K59 II	15.0*h*	14.3 ± 0.5	111 ± 9		cf. 13-27*b*7		
13-27*i*7	K59 III	—	14.2 ± 0.4*3 14.7 ± 0.4 14.7 ± 0.4	113 ± 16 120 ± 16 113 ± 15	rel. : cf. 3-6*h*4 $Li^6(n, t)\,He^4$ = 28.1 mb for E_n = 14.2 MeV Leaky-integrator	γ-activity, 3″ × 3″ NaI-well-crystal with a hole of 3/4″ ⌀ and 2″ depth. Calibration (total counts) with standard sources	Deviation contains : neutron-flux : ~7 % target position ~3 % stat. error ~3-5 % calibration ~6-9 %	Powder, 3/4″⌀, 1/2″ height
13-27*i*8	S59 II	—	14.8*4	117 ± 8	rel. : U^{238} fiss = ?	γ-activity, NaI crystal exp. calibrated	—	—
13-27*i*9	P61 IV	—	13.88 ± 0.10*5 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31 14.93 ± 0.36	128 ± 6.4 127 ± 6.4 124 ± 6.2 120 ± 6.5 118 ± 5.8 115 ± 5.8 113 ± 5.7	abs. : α-from $T(d, n)\,He^4$	β-activity, 2π geometry Corrections for absolute β-counting exp. determinated (cf. B59 I). Chemical separation	—	—

*1 Measured by the authors
*2 Also measured for 12 MeV $\leq E_n \leq$ 21 MeV
*3 Also measured for 13.0 MeV $\leq E_n \leq$ 15.7 MeV
*4 Also measured for 6.2 MeV $\leq E_n \leq$ 8.3 MeV
*5 Also measured for 7 MeV and 12.1 MeV $\leq E_n \leq$ 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX
13-27*i*10	G58	—	14.1 ± 0.04	116 ± 5.3	abs.: α from T(*dn*) He^4	β-activity. 2π and 4π geometry: corrections for abs. β-counting exp. determinated (cf. B59 I)	Estimated total error	Element
13-27*i*11	K57	—	14.8	82 ± 16	abs.: α from T(*d, n*) He^4	Nuclear plate. Al- foils between the plates. Separation of ρ and α by the « temperature method » (cf. D51). Separation of *n*,α-: *n*,*n*α-and *n*,α*n*-processes	Estimated total error	Al foils of 1.8 mg/cm² thickness
13-27*i*12	D60 II	—	14.5 ± 0.4	116 ± 9	rel.: cf. 29-63*a*3 $Cu^{63}(n, 2n)$ = 556 mb Sandwich-method	β-activity, prop. counter	—	Thickness : 27 mg/cm²
13-27*i*13	I61	—	No measurement for*1 14 MeV ≦ E_n ≦ 15 MeV			cf. 12-24*b*6		
13-27*i*14	S62	—	14.6 + 0.2 — 0.3	115 ± 2		cf. 37-87*a*1		
13-27*i*15	T60	—	13.9*2 14.0 14.1 14.6 15.1	95 89 87 107 93	—	—	—	—
13-27*i*16	G61 IV	—	14 14.4 14.5 14.7 14.8	124 ± 6 116 ± 3 118 ± 5 115 ± 6 109 ± 3	—	—	—	—

$Al^{27}(n, \alpha) Na^{24m}$

13-27*i*1*m*	G59 I	20 msec	14.5	40 ± 20		cf. 12-24*b*1*m*		

*1 Measured for 12.6 MeV ≦ E_n ≦ 18 MeV
*2 Also measured for 8.2 MeV ≦ E_n ≦ 15.1 MeV

SILICON

$Si^{28}(n, p)\ Al^{28}$

I	II	III	IV	V	VI	VII	VIII	IX
14-28*b*1	P53	2.4 min	14.5 ± 0.35	220 ± 50		cf. 7-14*a*1		
14-28*b*2	K59 III	—	14.0 ± 0.4*1 14.2 ± 0.4 14.7 ± 0.4 15.0 ± 0.4	440 ± 57 365 ± 29 340 ± 37 303 ± 30		cf. 13-27*i*7		
14-28*b*3	C56	—		cf. 12-24*b*8*2				
14-28*b*4	F58 II	—	14	~380	—	—	—	—

$Si^{28}(n, p)\ Al^{28} + Si^{28}(n, pn)\ Al^{27}$

I	II	III	IV	V	VI	VII	VIII	IX
14-28*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^\circ} =$ *a*) 243 ± 22 *b*) 246 ± 22		cf. 11-23*d*1		

$Si^{28}(n, np)\ Al^{27}$

I	II	III	IV	V	VI	VII	VIII	IX
14-28*e*1	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^\circ} =$ 27 ± 20		cf. 11-23*d*1		

$Si^{29}(n, p)\ Al^{29}$

I	II	III	IV	V	VI	VII	VIII	IX
14-29*b*1	P53	6.7 min	14.5 ± 0.35	101 ± 30		cf. 7-14*a*1		

$Si^{29}(n, 2p)\ Mg^{28}$

I	II	III	IV	V	VI	VII	VIII	IX
14-29*h*1	B62 II	21.3 *h*	14.7	≦ 0.50	—	—	—	—

*1 Also measured for 12.33 MeV $\leqq E_n \leqq$ 18.24 MeV
*2 Measured for 12.5 MeV $\leqq E_n \leqq$ 17.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Si^{30}(n, \alpha)\,Mg^{27}$				
14-30*i*1	P53	10 min	14.5 ± 0.35	45.9 ± 25		cf. 7-14*a*1		
				$Si^{nat}(n, p + n, pn)\,Al$				
14-*d*1 diff.	H62 III	—	14.4 ± 0.2	160 ± 16 for E_p > 2.9 MeV		cf. 12-*d*1		

I	II	III	IV	V	VI	VII	VIII	IX

PHOSPHORUS

$P^{31}(n, 2n) P^{30}$

I	II	III	IV	V	VI	VII	VIII	IX
15-31*a*1	R58 II	2.4 min	14	11.9		cf. 7-14*a*2		
15-31*a*2	F60	—	14.74 ± 0.27*1	8.7 ± 2.7		cf. 7-14*a*3		
15-31*a*3	R61 II	2.53 ± 0.12 min*2	14.4 ± 0.3	10.9 ± 8.5		cf. 7-14*a*7		
15-31*a*4	K62	2.55 min	14.8 ± 0.4	8.9 ± 1.2	rel.: cf. 29-63*a* $Cu^{63}(n, 2n)$ = 507 mb Sandwich-method	γ-activity, measuring of the area under the photo-peak with a 3 × 3″ NaI crystal. Calibration with standard sources	Probable total error	Powder

$P^{31}(n, p) Si^{31}$

I	II	III	IV	V	VI	VII	VIII	IX
15-31*b*1	P53	2.7*h*	14.5 ± 0.35	64.2 ± 8.4		cf. 7-14*a*1		
15-31*b*2	F52	170 min	14.1	91 ± 9		cf. 13-27*b*2		
15-31*b*3	G58	2.65*h*	14.1 ± 0.04	85.5 ± 7		cf. 13-27*i*10		
15-31*b*4	K62	2.65*h*	14.8 ± 0.4	82 ± 10		cf. 5-11*b*2		

$P^{31}(n, p) Si^{31} + P^{31}(n, pn) Si^{30}$

I	II	III	IV	V	VI	VII	VIII	IX
15-31*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^0} =$ *a*) 184 ± 14 *b*) 114 ± 14		cf. 11-23*d*1		
15-31*d*2 diff.	H62 III	—	14.4 ± 0.2	155 ± 16 for $E_p > 2.9$ MeV		cf. 12-*d*1		

*1 Also measured for 12.5 MeV $\leq E_n \leq$ 18 MeV
*2 Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
				$P^{31}(n, np) Si^{30}$				
15-31*e*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^\circ} =$ 163 ± 14		cf. 11-23*d*1		
15-31*e*2 diff.	H62 III	—	14.4 ± 0.2	70 ± 14 for $E_p > 2.9$ MeV		cf. 12-*d*1		
				$P^{31}(n, d) Si^{30}$				
15-31*f*1 diff.	C60 II	—	14.5	14.5 ± 2.8	abs.: proton-recoil-telescope	Telescope; 2 prop.-counters in coincidence with a CsI crystal and 1 prop. counter before the target in anticoinc. to the other counters	—	—
				$P^{31}(n, \alpha) Al^{28}$				
15-31*i*1	P53	2.4 min	14.5 ± 0.35	146 ± 30		cf. 7-14*a*1		
15-31*i*2	K62	2.3 min	14.8 ± 0.4	153 ± 20		cf. 15-31*a*4		
15-31*i*3	G61 IV	—	13.9 ± 0.15* 14.4 ± 0.12 14.9 ± 0.1	119 ± 5 117 ± 5 116 ± 5		cf. 12-24*b*10		

* Also measured for 13 MeV $\leq E_n \leq$ 16.6 MeV

SULPHUR

$S^{32}(n, p)\ P^{32}$

I	II	III	IV	V	VI	VII	VIII	IX
16-32*b*1	P53	14*d*	14.5 ± 0.35	369 ± 44		cf. 7-14*a*1		Element
16-32*b*2	A57 I	14.3*d*	13.89 ± 0.025* 14.1 ± 0.04 14.32 ± 0.16 14.53 ± 0.26 14.70 ± 0.29 14.83 ± 0.40 14.93 ± 0.45 14.95 ± 0.47	257 ± 13 248 ± 13 231 ± 12 225 ± 12 220 ± 11 213 ± 11 213 ± 11 214 ± 11	rel. : $S^{32}(n, p)$ = 254 ± 10 mb for E_n = 14.10 ± 0.04 MeV abs. : for E_n = 14.10 MeV α from T(*d*, *n*) He^4	β-activity, 4π geometry, prop. counter. Chemical separation	Probable error	Element 1″⌀ ; thickness = 3/32″

$S^{32}(n, p)\ P^{32} + S^{32}(n, pn)\ P^{31}$

I	II	III	IV	V	VI	VII	VIII	IX
16-32*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^o}$ = *a*) 365 ± 25 *b*) 289 ± 25		cf. 13-23*d*1		
16-32*d*2 diff.	C60 I	—	14.5	$4\pi\left[\frac{d\sigma}{d\theta}\right]$ = 109 ± 10, means for θ = 62°, 75°, 95°, 138°, 162° and *d*θ = 10°		cf. 15-31*f*1		
16-32*d*3 diff.	E59 III	—	14.1	185 ± 30 lower limit for σ. E_p > 5 MeV	abs. : proton recoil telescope	Telescope : 2 prop. counters in coincidence with a CsI	—	Element 31 mg/cm²

$S^{32}(n, np)\ P^{31}$

I	II	III	IV	V	VI	VII	VIII	IX
16-32*e*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^o}$ = 105 ± 25		cf. 11-23*d*1		

* Also measured for 1.59 MeV ≤ E_n ≤ 14.95 MeV

I	II	III	IV	V	VI	VII	VIII	IX
					$S^{32}(n, d)\ P^{31}$			
16-32*f*1 diff.	C60 II	—	14.5	14 ± 4.2		cf. 15-31*f*1		
					$S^{32}(n, t)\ P^{30}$			
16-32*h*1	W62	—	14.7 ± 0.3	0.020 ± 0.005		cf. 29-63*a*11		
16-32*h*2	P62	—	14.7	< 0.02	—	Counting of the tritium in a low-background prop. counter	—	—
					$S^{34}(n, p)\ P^{34}$			
16-34*b*1	P53	12.4 sec	14.5 ± 0.35	85.2 ± 38		cf. 7-14*a*1		
					$S^{34}(n, \alpha)\ Si^{31}$			
16-34*i*1	P53	2.7*h*	14.5 ± 0.35	138 ± 35		cf. 7-14*a*1		Element
16-34*i*2	A57 I	2.5 ± 0.2 *h*	14.10 ± 0.04	126 ± 7	rel. : cf. 16-32*b*2 $S^{32}(n, p) = 254$ mb		cf. 16-32*b*2	
					$S^{nat}(n, p + n, pn)\ P$			
16-*d*1 diff.	H62 III	—	14.4 ± 0.2	206 ± 21 for $E_p > 2.8$ MeV		cf. 12-*d*1		
					$S^{nat}(n, np)\ P$			
16-*e*1 diff.	H62 III	—	14.4 ± 0.2	73 ± 15 for $E_p > 2.8$ MeV		cf. 12-*d*1		
					$S^{nat}(n, \alpha)\ Si$			
16-*i*1 diff.	K58 III	—	14.8	38.2 ± 7.6	abs. : α from $T(d, n)\ He^4$	Nuclear plate : Separation of n, α- : $n, n\alpha$- ; and $n, \alpha n$-processes	Estimated total error	S^{nat}, 2.54 mg/cm²

I	II	III	IV	V	VI	VII	VIII	IX
					CHLORINE			
					$Cl^{35}(n, 2n) Cl^{34m}$			
17-35*a1m*	P53	33 min	14.5 ± 0.35	3.47 ± 1.56		cf. 7-14*a*1		
17-35*a2m*	S59 I	32.4 min	14.8 ± 0.8	5.6 ± 2		cf. 17-24*b*2		
17-35*a3m*	R59 I	37.7 min	14	5.3 ± 0.4	rel. : cf. 29-63*a* $Cu^{63}(n, 2n)$ = 500 mb	β^+-activity; 0.511 MeV annihilation radiation measured in coincidence with 2 NaI scint. counters	No systematic errors	—
17-35*a4m*	R61 II	31.2 ± 0.6 min*	14.4 ± 0.3	5.42 ± 0.41		cf. 7-14*a*7		
17-35*a5m*	K61 II	33 min	14.8 ± 0.5	12 ± 1.8	rel. : cf. 26-56*b* $Fe^{56}(n, p)$ = 126 mb Sandwich method	β-activity, prop. counter. Corrections for abs. β-counting computed	Error contains : neutron flux 2-5 %, statistics 2-8 %, decay const. 1 %, γ-pulses 3 %	Powder 20 mg/c²m. in tape of 9 mg/c²m. Purity 99.9 %
					$Cl^{35}(n, p) S^{35} + Cl^{35}(n, pn) S^{34}$			
17-35*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^0} =$ *a*) 125 ± 38 *b*) 107 ± 38		cf. 11-23*d*1		
					$Cl^{35}(n, \alpha) P^{32}$			
17-35*i*1	P53	14*d*	14.5 ± 0.35	191 ± 30		cf. 7-14*a*1		
17-35*i*2	S59 I	14.5*d*	14.8 ± 0.8	199 ± 32		cf. 17-37*b*2		
					$Cl^{37}(n, p) S^{37}$			
17-37*b*1	P53	5 min	14.5 ± 0.35	33.4 ± 7		cf. 7-14*a*1		NH_4Cl; NaCl; Licl

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
17-37*b*2	S59 I	5 min	14.8 ± 0.8	25.4 ± 2.1	rel. : cf. 29-63*a*3 $Cu^{63}(n, 2n)$ = 556 mb	β-activity, plastic-scintillator or prop. counter. Scattering and absorption of the β in the target is supposed to be the same as in the Cu-monitor	—	C_6Cl_6 ; 9.5-12.7 cm ⌀. thickness : ~85 mg/cm²
17-37*b*3	C56			cf. 12-24*b*8*				
					$Cl^{37}(n, \alpha)\ P^{34}$			
17-37*i*1	P53	12.4 sec	14.5 ± 0.35	52.4 ± 25		cf. 7-14*a*1		
17-37*i*2	S59I	12.5 sec	14.8 ± 0.8	43.8 ± 7		cf. 17-37*b*2		

* Measured for 12.5 MeV $\leq E_n \leq$ 17.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX

POTASSIUM

$K^{39}(n, 2n) K^{38}$

I	II	III	IV	V	VI	VII	VIII	IX
19-39*a*1	P53	7.7 min	14.5 ± 0.35	10 ± 5.5		cf. 7-14*a*1		KNO_3
19-39*a*2	R58 II	7.7 min	14	3.8		cf. 7-14*a*2		
19-39*a*3	R61 II	7.7 ± 0.5 min	14.4 ± 0.3	3.37 ± 0.27		cf. 7-14*a*7		
19-39*a*4	K61 II	7.7 min	14.8 ± 0.5	6 ± 0.9		cf. 17-35*a*5*m*		

$K^{39}(n, p) Ar^{39} + K^{39}(n, pn) Ar^{38}$

I	II	III	IV	V	VI	VII	VIII	IX
19-39*d*1	B60	—	14.1 ± 0.1	354 ± 53	rel.: KI(*n*, *p*) + KI(*n*,*np*) + KI(*n*, α) = 650 mb and I(*n*, *p*) neglected (cf. 53-127*b*1)	Total σ measured for all charged particles produced in the KI crystal. KI in coincidence with α from T(*d*, *n*) He^4. Separation of α-, *p*-, and γ-pulses by pulse-shape-discrimination. Separation of *n*,*p*- and *n*,*np*- reactions by stat. theory	Stat. error	KI-crystal

$K^{39}(n, np) Ar^{38}$

I	II	III	IV	V	VI	VII	VIII	IX
19-39*e*1	B60	—	14.1 ± 0.1	186 ± 27		cf. 19-39*d*1		

$K^{39}(n, \alpha) Cl^{36}$

I	II	III	IV	V	VI	VII	VIII	IX
19-39*i*1	B60	—	14.1 ± 0.1	84 ± 13	cf. 19-39*d*1	Instead of *n*. *p*-; *n*, *np* say *n*, α-; *n*, *n*α		

$K^{41}(n, p) Ar^{41}$

I	II	III	IV	V	VI	VII	VIII	IX
19-41*b*1	P53	110 min	14.5 ± 0.35	81.2 ± 32.5		cf. 7-14*a*1		KNO_3

I	II	III	IV	V	VI	VII	VIII	IX
					$K^{41}(n, He^3)\ Cl^{39}$			
19-41*f*1	B62 II	55.5 min	14.7	< 2.5	—	—	—	—
					$K^{41}(n, 2p)\ Cl^{40}$			
19-41*h*1	B62 II	1.4 min	14.7	< 0.090	—	—	—	—
					$K^{41}(n, \alpha)\ Cl^{38}$			
19-41*i*1	P53	38 min	14.5 ± 0.35	31.4 ± 11		cf. 7-14*a*1		KNO^3
19-41*i*2	B60	38 min	14.1 ± 0.1	12 ± 13	rel. : cf. 53-127*a* $I^{127}(n, 2n)$ = 1200 mb	β-activity. KI-crystal served as target and 4π counter	Stat. error	KI crystal

I	II	III	IV	V	VI	VII	VIII	IX

CALCIUM

$Ca^{40}(n, p)\,K^{40} + Ca^{40}(n, pn)\,K^{39}$

I	II	III	IV	V	VI	VII	VIII	IX
20-40*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^{\circ}} =$ *a*) 451 ± 38 *b*) 298 ± 38		cf. 11-23*d*1		

$Ca^{40}(n, np)\,K^{39}$

I	II	III	IV	V	VI	VII	VIII	IX
20-40*e*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^{\circ}} =$ 205 ± 37		cf. 11-23*d*1		

$Ca^{40}(n, t)\,K^{38}$

I	II	III	IV	V	VI	VII	VIII	IX
20-40*h*1	W62	—	14.7 ± 0.3	< 0.1		cf. 29-63*a*11		

$Ca^{42}(n, p)\,K^{42}$

I	II	III	IV	V	VI	VII	VIII	IX
20-42*b*1	H62 I	12.37 ± 0.09*h**	14.9	140 ± 45	rel.: cf. 13-27*i*10 $Al^{27}(n, \alpha)$ = 116 mb	γ-activity, measuring of the area under the photo-peak with a 1 × 1½″ NaI crystal	Mean total error	$CaCO_3$

$Ca^{44}(n, p)\,K^{44}$

I	II	III	IV	V	VI	VII	VIII	IX
20-44*b*2	H62 I	22 ± 0.3 min*	14.9	25 ± 12		cf. 20-42*b*1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
				$Ca^{44}(n, \alpha)\ Ar^{41}$				
20-44*i*I	H62 I	1.85*h*	14.9	35 ± 10		cf. 20-42*b*I		
				$Ca^{48}(n, 2n)\ Ca^{47}$				
20-48*a*I	H62 I	—	14.9	1070 ± 360		cf. 20-42*b*I		

I	II	III	IV	V	VI	VII	VIII	IX

SCANDIUM

$Sc^{45}(n, 2n) Sc^{44g}$

I	II	III	IV	V	VI	VII	VIII	IX
21-45*a*1*g*	P61 I	3.92*h*	14.01 ± 0.10	138.5 ± 5.2*[1]		cf. 22-46*a*2		
			14.09 ± 0.10	150.0 ± 5.7				
			14.31 ± 0.13	169.0 ± 6.4				
			14.50 ± 0.20	181.4 ± 6.9				
			14.68 ± 0.26	204.3 ± 77				
21-45*a*2*g*	M61 II	—	14.8	179 ± 27		cf. 11-23*i*2		
21-45*a*3*g*	R61 II	4.04 ± 0.08*[2]	14.4 ± 0.3	198 ± 15		cf. 7-14*a*7		
21-45*a*4*g*	K59 II	4.01*h*	14.3 ± 0.5	129 ± 9		cf. 13-27*b*7		
21-45*a*5*g*	K61 II	4.01*h*	14.8 ± 0.5	148 ± 22		cf. 17-35*a*5*m*		

$Sc^{45}(n, 2n) Sc^{44m}$

I	II	III	IV	V	VI	VII	VIII	IX
21-45*a*1*m*	P61 I	2.44*h*	14.01 ± 0.10	107.4 ± 3.5*[1]		cf. 22-46*a*2		
			14.09 ± 0.10	116.2 ± 3.7				
			14.31 ± 0.13	127.3 ± 4.1				
			14.50 ± 0.20	134.3 ± 4.3				
			14.68 ± 0.26	144.7 ± 4.6				
21-45*a*2*m*	M61 II	—	14.8	149 ± 22		cf. 11-23*i*2		
21-45*a*3*m*	R61 II	59.1 ± 1.2*h**[2]	14.4 ± 0.3	149 ± 11		cf. 7-14*a*7		Sc_2O_3

$Sc^{45}(n, 2n) Sc^{44tot}$

I	II	III	IV	V	VI	VII	VIII	IX
21-45*a*1*t*	P61 I	—	14.01 ± 0.10	249.5 ± 6.2*[1]		cf. 22-46*a*2		
			14.09 ± 0.10	266.2 ± 6.7				
			14.31 ± 0.13	296.3 ± 7.7				
			14.50 ± 0.20	315.7 ± 8.2				
			14.68 ± 0.26	349.0 ± 9.1				

*[1] Also measured for 11.6 MeV $\leq E_n \leq$ 19.6 MeV

*[2] Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
					$Sc^{45}(n, p)\,Ca^{45}$			
21-45*b*1	P61 I	—	14.09 ± 0.10 14.31 ± 0.13 14.54 ± 0.20 14.81 ± 0.31	54 ± 4*1 55.5 ± 4 57 ± 4 49.5 ± 4		cf. 22-46*a*2		
					$Sc^{45}(n, He^3)\,K^{43}$			
21-45*f*1	B62 II	22*h*	14.7	< 0.30				
					$Sc^{45}(n, 2p)\,K^{44}$			
21-45*h*1	B62 II	22 min	14.7	< 0.21	—	—	—	—
					$Sc^{45}(n, \alpha)\,K^{42}$			
21-45*i*1	K59 II	12.4*h*	14.3 ± 0.5	132 ± 8		cf. 13-27*b*7		
21-45*i*2	M61 II	—	14.8	63 ± 9.5		cf. 11-23*i*2		
21-45*i*3	P61 I		14.09 ± 0.10*2 14.31 ± 0.13 14.50 ± 0.20 14.81 ± 0.31	55 ± 2.7 55 ± 2.7 56.3 ± 2.8 53.5 ± 2.7		cf. 22-46*a*2		

*1 Also measured for 13.4 MeV $\leq E_n \leq$ 14.8 MeV
*2 Also measured for 8 MeV $\leq E_n \leq$ 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX

TITANIUM

$Ti^{46}(n, 2n) Ti^{45}$

I	II	III	IV	V	VI	VII	VIII	IX
22-46*a*1	R58 II	2.9*h*	14	27.9		cf. 7-14*a*2		
22-46*a*2	P61 I	3.09	13.88 ± 0.10*[1] 14.09 ± 0.10 14.50 ± 0.20 14.93 ± 0.36	7.0 ± 1 13 ± 3 28.0 ± 3 44.5 ± 3	rel. : cf. 13-27*i*9	β-activity, 2π geometry. Corrections for absolute β-counting exp. determinated (cf. B59 I). Measuring of the activity after chem. separation	—	—
22-46*a*3	P59 I	3.06 ± 0.08*h**[2]	14.8 ± 0.8	50.4 ± 8.1		cf. 13-27*b*4		Element, discs, 1.7-2.1 cm ∅ thickness 3 mg/cm²
22-46*a*4	R61 II	2.91 ± 0.06*h**[2]	14.4 ± 0.3	31.8 ± 2.4		cf. 7-14*a*7		

$Ti^{46}(n, p) Sc^{46}$

I	II	III	IV	V	VI	VII	VIII	IX
22-46*b*1	P59 I	85 ± 2*d**[2]	14.8 ± 0.8	~520		cf. 13-27*b*4		Element, nat., discs 1.7-2.1 cm ∅ 8 mg/₂ cm² thickness. TiO_2 powder enriched : Ti^{47}(86.6 %), Ti^{49} (81.1 %), Ti^{50}(84.69 %)
22-46*b*2	R62	—	—	~240	—	—	—	—

$Ti^{46}(n, p) Sc^{46} + Ti^{46} (n, pn) Sc^{45}$

I	II	III	IV	V	VI	VII	VIII	IX
22-46*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^o} =$ *a*) 203 ± 20 *b*) 196 ± 20		cf. 11-23*d*1		

*[1] Also measured for 13.4 MeV $\leq E_n \leq$ 19.5 MeV
*[2] Measured by the authors

$Ti^{47}(n, p)\,Sc^{47}$

I	II	III	IV	V	VI	VII	VIII	IX
22-47*b*1	P59 I	3.45 ± 0.06*d**1	14.8 ± 0.8	230 ± 39		cf. 13-27*b*4		cf. 22-46*b*1
22-47*b*2	R62	—	—	170	—	—	—	—

$Ti^{47}(n, p)\,Sc^{47} + Ti^{47}(n, pn)\,Sc^{46}$

I	II	III	IV	V	VI	VII	VIII	IX
22-47*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^\circ} =$ *a*) 112 ± 16 *b*) 111 ± 16		cf. 11-23*d*1		

$Ti^{48}(n, p)\,Sc^{48}$

I	II	III	IV	V	VI	VII	VIII	IX
22-48*b*1	P53	1.8*d*	14.5 ± 0.35	92.7 ± 32.4		cf. 7-14*a*1		TiHx
22-48*b*2	P59 I	14.0 ± 0.9*h**1	14.8 ± 0.8	58 ± 6.7		cf. 13-27*b*4		cf. 22-46*b*1
22-48*b*3	G61IV	—	13.9*2 14.4 ± 0.15 15	66 ± 2 66 ± 3 65 ± 3		cf. 12-24*b*10		

$Ti^{48}(n, p)\,Sc^{48} + Ti^{48}(n, pn)\,Sc^{47}$

I	II	III	IV	V	VI	VII	VIII	IX
22-48*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^\circ} =$ *a*) 29 ± 8 *b*) 29 ± 8		cf. 11-23*d*1		

$Ti^{49}(n, p)\,Sc^{49}$

I	II	III	IV	V	VI	VII	VIII	IX
22-49*b*1	P59 I	58 ± 2 min*1	14.8 ± 0.8	29 ± 5		cf. 13-27*b*4		cf. 22-46*b*1
22-49*b*2	K59 II	56.3 min	14.3 ± 0.5	97 ± 17		cf. 13-27*b*7		

*1 Measured by the authors
*2 Also measured for $12.7 \leqq E_n \leqq 17$ MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Ti^{50}(n, p)\ Sc^{50}$ I				
22-50*b*1 I	P59 I	1.80 ± 0.20 min*	14.8 ± 0.8	27 ± 6		cf. 13-27*b*4		cf. 22-46*b*1
22-50*b*2 I	K59 II	1.55 min	14.3 ± 0.5	147 ± 13		cf. 13-27*b*7		
				$Ti^{50}(n, p)\ Sc^{50}$ II				
22-50*b*1 II	P59 I	22 ± 0.3 min*	14.8 ± 0.8	48 ± 15		cf. 13-27*b*4		cf 22-46*b*1
				$Ti^{50}(n, 2p)\ Ca^{49}$				
22-50*h*1	B62 II	8.8 min	14.7	< 0.10	—	—	—	—
				$Ti^{nat}(n, p + n, pn)$ Sc				
22-*d*1 diff.	H62 III	—	14.4 ± 0.2	35 ± 4 for $E_p > 3.7$ MeV		cf. 12-*d*1		

* Measured by the authors

VANADIUM

$V^{51}(n, 2n) V^{50}$

I	II	III	IV	V	VI	VII	VIII	IX
23-51*a*1	A58 I	—	14.1	660 ± 50		cf. 1-2*a*1		Element

$V^{51}(n, p) Ti^{51}$

I	II	III	IV	V	VI	VII	VIII	IX
23-51*b*1	P53	6 min	14.5 ± 0.35	27 ± 4		cf. 7-14*a*1		V_2O
23-51*b*2	P61 IV	—	14.8	53 ± 5	—	—	—	—

$V^{51}(n, p) Ti^{51} + V^{51}(n, pn) Ti^{50}$

I	II	III	IV	V	VI	VII	VIII	IX
23-51*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta}\right]_{120^{\circ}} =$ *a*) 20 ± 7.0 *b*) 23 ± 7.0		cf. 11-23*d*1		

$V^{51}(n, He^{3}) Sc^{49}$

I	II	III	IV	V	VI	VII	VIII	IX
23-51*f*1	B62 II	57 min	14.7	< 0.33	—	—	—	—

$V^{51}(n, 2p) Sc^{50}$

I	II	III	IV	V	VI	VII	VIII	IX
23-51*h*1	B62 II	1.7 min	14.7	< 0.30	—	—	—	—

$V^{51}(n, \alpha) Sc^{48}$

I	II	III	IV	V	VI	VII	VIII	IX
23-51*i*1	P53	1.8*d*	14.5 ± 0.35	28.6 ± 7.8		cf. 7-14*a*1		
23-51*i*2	K58 III	—	14.8	43.2 ± 8.5		cf. 16-*i*1		Element,
23-51*i*3	B61 III	44*h*	14.4 ± 0.3	43 ± 3		cf. 29-65*a*8		2.54 mg/cm²

I	II	III	IV	V	VI	VII	VIII	IX
				$V^{51}(n, n\alpha)\ Sc^{47}$				
23-51*k*1	B62 I	81-4*h*	14.1 ± 0.1*1	3 ± 2	rel. : cf. 13-27*i* $Al^{27}(n, \alpha)$ = 118 mb	cf. 29-65*a*8		V_2O_3 powder
23-51*k*2	B62 II	3.4*d*	14.7	< 5	—	—	—	—

*1 Also measured from threshold to 19.6 MeV

CHROMIUM

I	II	III	IV	V	VI	VII	VIII	IX
				$Cr^{50}(n, 2n)\ Cr^{49}$				
24-50*a*1	R58 II	38.5 min	14	25.4		cf. 7-14*a*2		
24-50*a*2	M61 II	—	14.8	32 ± 3		cf. 11-23*i*2		
24-50*a*3	R61 II	38.5 ± 1.5 min*	14.4 ± 0.3	26.4 ± 2.2		cf. 7-14*a*7		Element
24-50*a*4	K61 II	41.6 min	14.8 ± 0.5	27 ± 6.8		cf. 17-35*a*5m		
				$Cr^{50}(n, p)\ V^{50} + Cr^{50}(n, pn)\ V^{49}$				
24-50*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^0} =$ *a*) 265 ± 21 *b*) 277 ± 20		cf. 11-23*d*1		
				$Cr^{50}(n, np)\ V^{49}$				
24-50*e*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^0} =$ 153 ± 21		cf. 11-23*d*1		
				$Cr^{52}(n, 2n)\ Cr^{51}$				
24-52*a*1	W61 I	—	15.0	280 ± 50	rel.: cf. 13-27*i*10 $Al^{27}(n, \alpha) = 116$ mb	γ-activity. Measuring of the area under the photopeak and K-electron capture	Total error	—
24-52*a*2	H62 I	—	14.9	280 ± 50		cf. 20-48*a*1		
				$Cr^{52}(n, p)\ V^{52}$				
24-52*b*1	P53	3.9 min	14.5 ± 0.35	77.7 ± 11		cf. 7-14*a*1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
24-52*b*2	K59 III	—	14.0 ± 0.4* 14.2 ± 0.4 14.5 ± 0.4 14.7 ± 0.4 15.0 ± 0.4 15.0 ± 0.4	133 ± 15 109 ± 13 106 ± 10 113 ± 12 114 ± 11 101 ± 10		cf. 13-27*i*7		
24-52*b*3	M61 II	—	14.8	105 ± 10		cf. 11-23*i*2		
24-52*b*4	F58 II	—	—	∼103	—	—	—	—
24-52*b*5	C61 II	—	—	83 ± 10	—	—	—	—

$Cr^{52}(n, p)\,V^{52} + Cr^{52}(n, pn)\,V^{51}$

I	II	III	IV	V	VI	VII	VIII	IX
24-52*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^o} =$ *a*) 74 ± 10 *b*) 67 ± 10		cf. 11-23*d*1		

$Cr^{53}(n, p)\,V^{53}$

I	II	III	IV	V	VI	VII	VIII	IX
24-53*b*1	C61 II	—	14.8	37 ± 4	—	—	—	—

$Cr^{53}(n, p)\,V^{53} + Cr^{53}\,(n, pn)\,V^{52}$

I	II	III	IV	V	VI	VII	VIII	IX
24-53*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^o} =$ *a*) 44 ± 6.6 *b*) 48 ± 7.2		cf. 11-23*d*1		

* Also measured for 12.33 MeV $\leq E_n \leq$ 18.24 MeV

MANGANESE

$Mn^{55}(n, 2n)\ Mn^{54}$

I	II	III	IV	V	VI	VII	VIII	IX
25-55*a*1	W61 I	—	14.1	600 ± 120		cf. 24-51*a*1		
25-55*a*2	W60 II	291*d*	14.5 ± 0.5	825 ± 190		cf. 29-65*a*10		
25-55*a*3	H62 I	—	14.1	600 ± 120		cf. 20-48*a*1		

$Mn^{55}(n, p)\ Cr^{55} + Mn^{55}(n, pn)\ Cr^{54}$

25-55*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^\circ} =$ *a*) 43 ± 7 *b*) 45 ± 7		cf. 11-23*d*1		

$Mn^{55}(n, He^3)\ V^{53}$

25-55*f*1	B62 II	1.7 min	14.7	< 0.42	—	—	—	—

$Mn^{55}(n, p + n, pn + n, np + n, d)\ Cr$

25-55*g*1	A58 III	—	14	110 ± 15	rel. : cf. 28-*b*, *d* $Ni^{nat}(n, p) = 440$ mb	Nuclear plate	—	12 mg/cm² thickness

$Mn^{55}(n, 2p)\ V^{54}$

25-55*h*1	B62 II	55 sec	14.7	< 0.36	—	—	—	—

$Mn^{55}(n, \alpha)\ V^{52}$

25-55*i*1	P53	3.9 min	14.5 ± 0.35	52.5 ± 7.9		cf. 7-14*a*1		MnO_2
25-55*i*2	K58 III	—	14.8	39.4 ± 8		cf. 16-*i*1		3.3 mg/cm² thickness

I	II	III	IV	V	VI	VII	VIII	IX
25-55*i*3	G61 IV	—	14.3 ± 0.1*	31 ± 2	—	—	—	—
			14.7 ± 0.2	33 ± 3				
			14.9 ± 0.2	34 ± 2				
25-55*i*4	F61 I	—	14.8	11.8 ± 0.7	—	—	—	—

* Also measured for 12.4 MeV $\leq E_n \leq$ 17.7 MeV

I	II	III	IV	V	VI	VII	VIII	IX

IRON

$Fe^{54}(n, 2n)\ Fe^{53}$

I	II	III	IV	V	VI	VII	VIII	IX
26-54*a*1	R58 II	9.8 min	14	16.7		cf. 7-14*a*2		
26-54*a*2	P61 III	8.3 ± 0.5 min*	14.1 ± 0.1	11 ± 2		cf. 13-27*b*8		Element
26-54*a*3	C61 I	8.4 ± 0.4 min*	14.8 ± 0.9	7.9 ± 0.8		cf. 27-59*a*1*g*		$Fe_2^{54}O_3$ enriched (99.6 %) thickness 10-55 mg/cm^2
26-54*a*4	D60 II	—	15 ± 0.4	~7		cf. 26-56*b*11		thickness ~27 mg/cm^2
26-54*a*5	R61 II	8.80 ± 0.24 min*	14.4 ± 0.3	15.0 ± 1.3		cf. 7-14*a*7		Element

$Fe^{54}(n, p)\ Mn^{54}$

I	II	III	IV	V	VI	VII	VIII	IX
26-54*b*1	P61 III	260 ± 15*d**	14.1 ± 0.1	254 ± 28		cf. 13-27*b*8		Element

$Fe^{54}(n, p)\ Mn^{54} + Fe^{54}(n, pn)\ Mn^{53}$

I	II	III	IV	V	VI	VII	VIII	IX
26-54*d*1	A57 II	—	14.1	460 ± 92		cf. 13-27*d*1		Fe^{54} enriched, thickness 5-12 mg/cm^2
26-54*d*2 diff.	A59	—	14.1	*a*) $4\frac{d\sigma}{d\Omega} = 395$ for $d\Omega = 90^o—180^o$ *b*) $2\frac{d\sigma}{d\Omega} = 415$ for $d\Omega = 0^o—180^o$	abs.: α-from $T(d, n)\ He^4$	Shielded nuclear plate surrounded by several targets arranged on a circle. Separation of *n,p*- and *n,np*-processes by stat. theory	—	Fe^{54} enriched: —88.4 %; thickness 27 mg/cm^2
26-54*d*3 diff.	A61 I	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^o} =$ *a*) 382 ± 13 *b*) 382 ± 13		cf. 11-23*d*1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
26-54*d*4 diff.	S60	—	14.1	$2\frac{d\sigma}{d\Omega} = 333 \pm 66$ for $d\Omega = 0^\circ - 180^\circ$		cf. 13-27*d*3		
26-54*d*5 diff.	M58 I	—	13.5 ± 0.1	306 for isotr. part 376 for total	abs. : recoil protons in a nuclear plate	Nuclear plate. Separation of *n*, *p*- and *n*, *np*-processes by stat. theory. σ probably contains *n*, *d*-processes	—	Fe^{54} enriched : 67 %, thickness 7 mg/cm²

$Fe^{54}(n, np)\,Mn^{53}$

I	II	III	IV	V	VI	VII	VIII	IX
26-54*e*1	A57 II	—	14.1	220 ± 44		cf. 13-27*d*1		
26-54*e*2 diff.	A61		14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^\circ} = 218 \pm 13$		cf. 11-23*d*1		
26-54*e*3 diff.	M58 II	—	13.5 ± 0.1	224		cf. 26-54*d*5		

$Fe^{54}(n, t)\,Mn^{52m}$

I	II	III	IV	V	VI	VII	VIII	IX
26-54*h*1*m*	C61 I	21 ± 2 min*	14.8 ± 0.9	0.6 ± 0.1		cf. 27-59*a*1*g*		cf. 26-54*a*3

$Fe^{54}(n, \alpha)\,Cr^{51}$

I	II	III	IV	V	VI	VII	VIII	IX
26-54*i*1	P61 III	$25 \pm 2d$*	14.1 ± 0.1	131 ± 24		cf. 13-27*b*8		
26-54*i*2	C61 I	$25 \pm 5d$*	14.8 ± 0.9	270 ± 135		cf. 27-59*a*1*g*		cf. 26-54*a*3

$Fe^{56}(n, 2n)\,Fe^{55}$

I	II	III	IV	V	VI	VII	VIII	IX
26-56*a*1	H62 I	—	14.9	440 ± 88		cf. 20-48*a*1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
				$Fe^{56}(n, p)\ Mn^{56}$				
26-56*b*1	P53	2.6*h*	14.5 ± 0.35	96.7 ± 11.6		cf. 7-14*a*1		Element
26-56*b*2	F52	2.59*h*	14.1	124 ± 12		cf. 13-27*b*2		
26-56*b*3	Y57	2.57*h*	14.1 ± 0.15	144 ± 19		cf. 26-56*b*3		
26-56*b*4	P61 III	2.58 ± 0.03*h**1	14.1 ± 0.1	112.5 ± 5.6		cf. 13-27*b*8		
26-56*b*5	C61 I	2.56 ± 0.11*h**1	14.8 ± 0.9	128 ± 13		cf. 27-29*a*1*g*		Element-nat. Fe_2O_3 enriched : Fe^{58}(78.4 %); Fe^{57}(76.7 %) thickness 10-25 mg/cm^2
26-56*b*6	C55	—	14	72 ± 7	—	Activation	—	—
26-56*b*7	D60 II	—	15 ± 0.4	128 ± 13	rel. : cf. 29-63*a*3 $Cu^{63}(n, 2n)$ = 556 mb Sandwich-method	β-activity, prop. counter, nearly 2π geometry	—	Foils of 1.8 cm², thickness 27 mg/cm²
26-56*b*8	K59 III	—	15.27 ± 0.33	131 ± 15		cf. 13-27*i*7		
26-56*b*9	T58	Rel. measurement. Experimental*2 curve was fitted by σ = 110 ± 10 mb for E_n = 14.3 MeV				β-activity, geiger counter	—	Fe nat10″ long ½″⌀
26-56*b*10	B62 I	Rel. measurement. Experimental curve*3 was fitted by σ = 112.5 mb for E_n = 14.1 MeV cf. 26-56*b*4				cf. 13-27*b*8		
				$Fe^{56}(n, p)\ Mn^{56} + Fe^{56}(n, pn)\ Mn^{55}$				
26-56*d*1	A57 II	—	14.1	190 ± 38		cf. 13-27*d*1		
26-56*d*2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega}\right]_{120^\circ} =$ *a*) 82 ± 7.3 *b*) 86 ± 7		cf. 11-23*d*1		

*1 Measured by the authors
*2 Measured for 3.4 MeV ≦ E_n ≦ 8.2 MeV and 12.4 MeV ≦ E_n ≦ 17.9 MeV
*3 Measured for 13 MeV ≦ E_n ≦ 19 MeV

I	II	III	IV	V	VI	VII	VIII	IX
26-56*d*3 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 90 \pm 18$ for $d\Omega = 0^{\circ} - 180^{\circ}$		cf. 13-27*d*3		
26-56*d*4 diff.	A58 I	—	13.5 ± 0.1	75 for isotr. part 95 for total		cf. 26-54*d*5		Fe^{56} enriched : 99.9 %, thickness 4.5 mg/cm²

$Fe^{56}(n, np)\ Mn^{55}$

I	II	III	IV	V	VI	VII	VIII	IX
26-56*e*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^{\circ}} = 35 \pm 7$		cf. 11-23*d*1		

$Fe^{57}(n, p)\ Mn^{57}$

I	II	III	IV	V	VI	VII	VIII	IX
26-57*b*1	P61 III	1.4 ± 0.2 min*	14.1 ± 0.1	50 ± 8		cf. 13-27*b*8		
26-57*b*2	C61 I	1.5 ± 0.1 min*	14.8 ± 0.9	71 ± 7		cf. 27-59*a*1*g*		cf. 26-56*b*5

$Fe^{57}(n, pn + n, np + n, d)\ Mn^{56}$

I	II	III	IV	V	VI	VII	VIII	IX
26-57*c*1	C61 I	$2.56 \pm 0.20h$*	14.8 ± 0.9	6.1 ± 2.6		cf. 27-59*a*1*g*		cf. 26-56*b*5

$Fe^{58}(n, p)\ Mn^{58}$

I	II	III	IV	V	VI	VII	VIII	IX
26-58*b*1	C61 I	1.1 ± 0.1 min*	14.8 ± 0.9	23 ± 3.5		cf. 27-59*a*1*g*		cf. 26-56*b*5

$Fe^{58}(n, \alpha)\ Cr^{55}$

I	II	III	IV	V	VI	VII	VIII	IX
26-58*c*1	C61 I	3.5 ± 0.1 min*	14.8 ± 0.9	21.5 ± 2		cf. 27-59*a*1*g*		cf. 26-56*b*5

$Fe^{nat}(n, 2n)$

I	II	III	IV	V	VI	VII	VIII	IX
26-*a*1	A58 II	—	14.1	500 ± 40		cf. 1-2*a*1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

$Fe^{nat}(n, p + n, pn)$

26-*d*1 diff.	H62 III	—	14.4 ± 0.2	102 ± 10 for $E_p > 2.8$ MeV		cf. 12-*d*1		

$Fe^{nat}(n, p + n, pn + n, np + nd)$

26-*g*1 diff.	V57	—	14.5	$4\pi\left[\frac{d\sigma}{d\theta}\right] = 90 \pm 15$ means for $\theta = 30°$, 45°, 60°, 90°, 120°, 135°, 150°, and $E_p >$ 6 MeV		cf. 12-*g*1		

I	II	III	IV	V	VI	VII	VIII	IX
				COBALT				
				$Co^{59}(n, 2n) Co^{58}$ - tot.				
27-59*a*1*t*	W60 II	—	14.5 ± 0.5	855 ± 190		cf. 29-65*a*10		
27-59*a*2*t*	B61 III	70 ± 2*d*[*1] for Co^{58g}	14.4 ± 0.3[*2]	640 ± 64		cf. 29-65*a*8		CoO
27-59*a*3*t*	H61 I	—	14.1	630 ± 126		cf. 20-48*a*1		
27-59*a*4*t*	G61 IV	—	14.25 ± 0.05[*3] 14.5 ± 0.1 14.75 ± 0.1 15 ± 0.15	870 ± 130 930 ± 100 1020 ± 120 970 ± 100	—	—	—	—
27-59*a*5*t*	W62	71.4*d* for Co^{58g}	13.86 ± 0.10 14.11 ± 0.10 14.37 ± 0.15 14.59 ± 0.20 14.77 ± 0.25	727 ± 58 776 ± 62 767 ± 61 823 ± 66 827 ± 66		cf. 29-63*a*11		
				$Co^{59}(n, 2n) Co^{58g}$				
27-59*a*1*g*	P60 I	72*d*	14.8 ± 0.9	145 ± 5	rel. : cf. 29-65*a* $Cu^{65}(n, 2n)$ = 1000 mb ; cf. 13-27*i* : $Al^{27}(n, \alpha)$ = 115 mb ; cf. 29-63*a*3 : Cu^{63} $(n, 2n)$ = 556 mb Sandwich method	β- and γ-activity *a*) β-activity : cf. 13-27*b*4 *b*) γ-activity : 1 × 1.5″ NaI crystal. Corrections for abs. γ-counting cf. B55 I Chemical separation	cf. 13-27*b*4	Element, discs, thickness : 3-35 mg/cm²
27-59*a*2*g*	W60 II	71*d*	14.5 ± 0.5	473 ± 120		cf. 29-65*a*1		

[*1] Measured by the authors
[*2] Also measured for 12.6 MeV ≤ E_n ≤ 19.6 MeV
[*3] Also measured for 12.6 MeV ≤ E_n ≤ 17.1 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Co^{59}(n, 2n)\ Co^{58m}$				
27-59*a*1*m*	P60 I	9.0 ± 0.2*h* *1	14.8 ± 0.9	4 ± 2		cf. 27-59*a*1*g*		
27-59*a*2*m*	B62 I	9*h*	14.5 ± 0.5 *2	385 ± 100		cf. 29-65*a*8		
				$Co^{59}(n, p)\ Fe^{59}$				
27-59*b*1	P60 I	45*d*	14.8 ± 0.9	82 ± 8		cf. 27-59*a*1*g*		
27-59*b*2	W60 II	—	14.5 ± 0.5	80 ± 23		cf. 29-65*a*10		
				$Co^{59}(n, p)\ Fe^{59} + Co^{59}(n, pn)\ Fe^{58}$				
27-59*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega}\right]_{120^\circ} =$ *a*) 81 ± 10 *b*) 61 ± 10		cf. 11-23*d*1		
27-59*d*2 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 75 \pm 15$ for $d\Omega = 0^\circ - 180^\circ$		cf. 13-27*d*3		
27-59*d*3 diff.	H62 III	—	14.4 ± 0.2	48 ± 5 for $E_p > 3$ MeV		cf. 12-*d*1		
				$Co^{59}(n, np)\ Fe^{58}$				
27-59*e*1 diff.	H62 III	—	14.4 ± 0.2	~11 for $E_p > 3$ MeV		cf. 12-*d*1		
				$Co^{59}(n, He^3)\ Mn^{57}$				
27-59*f*1	B62 II	1.7 min	14.7	< 0.10	—	—	—	—

*1 Measured by the authors
*2 Also measured for 12.6 MeV $\leq E_n \leq$ 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX

$Co^{59}(n, \alpha) Mn^{56}$

I	II	III	IV	V	VI	VII	VIII	IX
27-59*i*1	P53	2.6*h*	14.5 ± 0.35	39.1 ± 7.5		cf. 7-14*a*1		
27-59*i*2	P60 I	2.57 ± 0.02*h**[1]	14.8 ± 0.9	30 ± 3		cf. 27-59*a*1*g*		
27-59*i*3	B58	2.59*h*	14.05 ± 0.55	31 ± 3	rel. : cf. 26-56*b* $Fe^{56}(n, p)$ = 110 mb Sandwich-method	β-activity, prop.-counter. Corrections for abs. β-counting : cf. N52, J50. Chemical separation	Estimated total error	Powder 3/4″ × 1 1/2″ thickness : 3/4-1 mg/cm²
27-59*i*4	K58 III	—	14.8	25 ± 5		cf. 16-*i*1		
27-59*i*5	W60 II	2.58*h*	14.5 ± 0.5	29 ± 6		cf. 29-65*a*10		
27-59*i*6	G61 IV	—	14.3*[2] 15.0	36 ± 4 30 ± 4	—	—	—	—
27-59*i*7	B61 III	2.57*h*	14.4 ± 0.3*[3]	29 ± 3		cf. 29-65*a*8		

*[1] Measured by the authors
*[2] Also measured for 12.6 MeV ≤ E_n ≤ 17.1 MeV
*[3] Also measured for 12.6 MeV ≤ E_n ≤ 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX

NICKEL

$Ni^{58}(n, 2n) Ni^{57}$

I	II	III	IV	V	VI	VII	VIII	IX
28-58*a*1	P53	36*h*	14.5 ± 0.35	40.6 ± 12		cf. 7-14*a*1		
28-58*a*2	P61 I	37 ± 1*h**1	14.8 ± 0.8	52 ± 2.6		cf. 27-59*a*1*g*		Element, Ni^{58} enriched: 99.63%; thickness : 3-5 mg/cm²
28-58*a*3	R59 I	44*h*	14	33.4 ± 2.7		cf. 17-35*a*3*m*		
28-58*a*4	P59 II	36*h*	14.1	38.8 ± 8.2	rel. : cf. 29-65*a* $Cu^{65}(n, 2n)$ = ?	β^+ activity; 0.511 MeV annihilation radiation measured in coinc. with 2 scintillation-counters. Calibration with Na^{22}	Neutron-flux : 7 %, calibration : 12 %	Element, nat.
28-58*a*5	P61 I	36*h*	13.88 ± 0.10*2 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.81 ± 0.31	21.4 ± 1.1 23.5 ± 1.3 31.1 ± 1.6 34.3 ± 1.7 39.3 ± 2.0		cf. 22-46*a*2		
28-58*a*6	R61 II	43.7 ± 0.9*h**1	14.4 ± 0.3	34.2 ± 2.6		cf. 7-14*a*7		
28-58*a*7	G62	37*h*	13.86 ± 0.10 14.11 ± 0.10 14.24 ± 0.10 14.37 ± 0.15 14.49 ± 0.20 14.59 ± 0.20 14.69 ± 0.25 14.77 ± 0.25 14.88 ± 0.30	18.7 ± 1.5 22.9 ± 1.8 27.2 ± 2.2 29.3 ± 2.3 31.7 ± 2.5 33.5 ± 2.7 35.9 ± 2.9 36.2 ± 2.9 39.5 ± 3.2		cf. 29-63*a*11		

*1 Measured by the authors
*2 Also measured from 12.2 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
28-58*a*8	M52		Only relative measurement*1			β-activity ; geiger-counter	—	—
					$Ni^{58}(n, p)\ Co^{58}$			
28-58*b*1	P59 II	—	14.1	560 ± 110		cf. 28-58*a*4		
					$Ni^{58}(n, p)\ Co^{58g}$			
28-58*b*1*g*	P60 I	72*d*	14.8 ± 0.9	237 ± 20		cf. 27-59*a*1*g*		NiO powder enriched : Ni^{61}(83.1 %) ; Ni^{62}(97.8 %) ; Ni^{64} (95.9 %) Element, powder enriched : Ni^{60}(99.1 %) Element, foils enriched : Ni^{58}(99.6 %) Thickness 3-35 mg/cm²
28-58*b*2*g*	G62	71.4*d*	13.86 ± 0.10 14.11 ± 0.10 14.24 ± 0.10 14.37 ± 0.15 14.49 ± 0.20 14.59 ± 0.20 14.69 ± 0.25 14.77 ± 0.25 14.88 ± 0.30	436 ± 35 435 ± 35 437 ± 35 424 ± 34 401 ± 32 385 ± 31 363 ± 29 355 ± 28 333 ± 27		cf. 29-63*a*11		
					$Ni^{58}(n, p)\ Co^{58m}$			
28-58*b*1*m*	P60 I	9.0 ± 0.2*h**2	14.8 ± 0.9	40 ± 15		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*
					$Ni^{58}(n, pn + n, np + n, d)\ Co^{57}$			
28-58*c*1	P59 II	270*d*	14.1	160 ± 40		cf. 28-58*a*4		

*1 Measured for 12 MeV $\leq E_n \leq$ 18.5 MeV
*2 Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
28-58*c*2	G62	270*d*	13.86 ± 0.10 14.11 ± 0.10 14.24 ± 0.10 14.37 ± 0.15 14.49 ± 0.20 14.59 ± 0.20 14.69 ± 0.25 14.77 ± 0.25 14.88 ± 0.30	490 ± 49 560 ± 56 520 ± 52 530 ± 53 600 ± 60 580 ± 58 560 ± 56 580 ± 58 580 ± 58		cf. 28-58*a*4		

$$Ni^{58}(n,p)\,Co^{58} + Ni^{58}(n,pn)\,Co^{57}$$

I	II	III	IV	V	VI	VII	VIII	IX
28-58*d*1	A57 II	—	14.1	310 ± 60		cf. 13-27*d*1		
28-58*d*2 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^0} =$ *a*) 440 ± 26 *b*) 430 ± 26		cf. 11-23*d*1		
28-58*d*3 diff.	S60	—	14.1	$2\cdot\frac{d\sigma}{d\Omega} = 534 \pm 100$ for $d\Omega = 0^0$— 180^0		cf. 13-27*d*3		
28-58*d*4 diff.	G61 II	—	14.8 ± 0.3	$4\pi\left[\frac{d\sigma}{d0}\right] =$ *a*) 430 ± 18 for isotr. part *b*) 490 ± 21 for total Means for 10 angles between 0^0 and 150^0 with $d0 = \pm 7^0$— $\pm 4^0$	abs.: α-from T(*d*, *n*) He^4 and proton- recoil- telescope	Telescope: 2 prop.-counters and CsI crystal in coinc. with α from T(*d*, *n*) He^4. Separation of *d*,*n* processes. Separation of *n*, *p*- and *n*,*np*-processes by stat. theory. Protons with $E_p > 1.8$ MeV measured. Protons with $E_p <$ 1.8 MeV computed by stat. theory	Mean total error	Ni^{58} enriched: 95.6 %, 2.7 cm ∅; thickness 10 mg/cm²
28-58*d*5 diff.	K60 I	—	14.8 ± 0.8	$4\pi\left[\frac{d\sigma}{d0}\right] = 287 \pm 29$ Means for 8 angles between 0^0 and 180^0	abs.: α from T(*d*,*n*) He^4	8 nuclear plates cyl. arranged around the target. Separation of *n*,*p*-and *n*, *np*-processes by stat. theory. σ probably contains *n*,*d*-processes	—	Ni^{58} enriched 99.6%; thickness 17.3 mg/cm²

I	II	III	IV	V	VI	VII	VIII	IX
				$Ni^{58}(n, np)\,Co^{57}$				
28-58*e*1	A57 II	—	14.1	220 ± 44		cf. 13-27*d*1		
28-58*e*2 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^0} =$ 343 ± 27		cf. 11-23*d*1		
28-58*e*3 diff.	G61 II	—	14.8 ± 0.3	$4\pi\left[\frac{d\sigma}{d0}\right] = 340 \pm 30$ Means for 10 angles between 0° and 150°		cf. 28-58*d*4		
28-58*e*4 diff.	K60 I	—	14.8 ± 0.8	$4\pi\left[\frac{d\sigma}{d0}\right] = 150 \pm 15$ Means for 8 angles between 0° and 180°		cf. 28-58*d*5		
				$Ni^{58}(n, d)\,Co^{57}$				
28-58*f*1 diff.	G61 II	—	14.8 ± 0.3	$4\pi\left[\frac{d\sigma}{d0}\right] = 25 \pm 6$ Means for 10 angles between 0° and 150°		cf. 28-58*d*4		
				$Ni^{60}(n, p)\,Co^{60m}$				
58-60*b*1*m*	P60 I	10.5 ± 0.2 min*	14.8 ± 0.9	9 ± 2		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*
				$Ni^{60}(n, p)\,Co^{60} + Ni^{60}(n, pn)\,Co^{59}$				
28-60*d*1	A57 II	—	14.1	240 ± 50		cf. 13-27*d*1		
28-60*d*2 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^0} =$ *a*) 124 ± 9 *b*) 134 ± 9		cf. 11-23*d*1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
28-60*d*3 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 158 \pm 32$ for $d\Omega = 0^{o} - 180^{o}$				
28-60*d*4 diff.	M58 II	—	13.5 ± 0.1	87 for isotr. part 155 for total part		cf. 26-54*d*5		Ni^{60} enriched 99.2 % – 1 cm^2 thickness 7 mg/cm^2

$Ni^{60}(n, np)\, Co^{59}$

I	II	III	IV	V	VI	VII	VIII	IX
28-60*e*1	A57 II	—	14.1	60 ± 12		cf. 13-27*d*1		
28-60*e*2 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^{o}} = 51 \pm 10$		cf. 11-23*d*1		
28-60*e*3 diff.	M58 II	—	13.5 ± 0.1	68		cf. 26-54*d*5		cf. 28-60*d*4

$Ni^{61}(n, p)\, Co^{61}$

I	II	III	IV	V	VI	VII	VIII	IX
28-61*b*1	P53	1.75*h*	14.5 ± 0.35	181 ± 25		cf. 7-14*a*1		
28-61*b*2	P60 I	$1.70 \pm 0.05h$*	14.8 ± 0.9	22 ± 2		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*

$Ni^{61}(n, pn + n, np + n, d)\, Co^{60m}$

I	II	III	IV	V	VI	VII	VIII	IX
28-61*c*1*m*	P60 I	10.5 ± 0.2 min*	14.8 ± 0.8	3.8 ± 1		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*

$Ni^{62}(n, p)\, Co^{62g}$

I	II	III	IV	V	VI	VII	VIII	IX
28-62*b*1*g*	P60 I	13.8 ± 0.2 min*	14.8 ± 0.8	3.3 ± 1		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*

$Ni^{62}(n, p)\, Co^{62m}$

I	II	III	IV	V	VI	VII	VIII	IX
28-62*b*1*m*	P60 I	1.9 ± 0.3 min*	14.8 ± 0.8	2.0 ± 0.5		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*

* Measured by the authors

$Ni^{62}(n, pn + n, np + n, d) Co^{61}$

I	II	III	IV	V	VI	VII	VIII	IX
28-62*c*2	P60 I	1.70 ± 0.05*h**	14.8 ± 0.8	0.65 ± 0.15		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*

$Ni^{64}(n, p) Co^{64g}$

I	II	III	IV	V	VI	VII	VIII	IX
28-64*b*1*g*	P60 I	7.8 ± 0.2 min*	14.8 ± 0.8	< 4.1		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*

$Ni^{64}(n, p) Co^{64m}$

I	II	III	IV	V	VI	VII	VIII	IX
28-64*b*1*m*	P60 I	2.0 ± 0.2	14.8 ± 0.8	> 0.43		cf. 27-59*a*1*g*		cf. 28-58*b*1*g*

$Ni^{nat}(n, p + n, pn) Co$

I	II	III	IV	V	VI	VII	VIII	IX
28-*d*1 diff.	H62 III	—	14.4 ± 0.2	255 ± 6 for $E_p > 1.5$ MeV		cf. 12-*d*1		

$Ni^{nat}(n, np) Co$

I	II	III	IV	V	VI	VII	VIII	IX
28-*e*1 diff.	H62 III	—	14.4 ± 0.2	240 ± 50 for $E_p > 1.5$ MeV		cf. 12-*d*1		

$Ni^{nat}(n, p + n, pn + n, np + n, d) Co$

I	II	III	IV	V	VI	VII	VIII	IX
28-*g*1 diff.	V57	—	14	$4\pi\left[\frac{d\sigma}{d\theta}\right] = 170 \pm 20$ Means for θ = 30°, 45°, 60°, 90°, 120°, 135°, 150° and $E_p >$ 6 MeV		cf. 12-*g*1		

*[1]Measured by the authors

COPPER

$Cu^{63}(n, 2n)Cu^{62}$

I	II	III	IV	V	VI	VII	VIII	IX
29-63*a*1	P53	10 min	14.5 ± 0.35	482 ± 72		cf. 7-14*a*1		
29-63*a*2	F52	9.9 min	14.1	510 ± 36		cf. 13-27*b*2		
29-63*a*3	Y57	10.1 min	14.1 ± 0.15	556 ± 28		cf. 13-27*b*3		
29-63*a*4	B52 I	10 min	14.25 ± 0.25*[1]	650 ± 80	rel. : cf. B51 σ $T(d, n) He^4$ for E_d = 10.5 MeV	β-activity, prop. counter, 2π geometry. Calibration with Cu^{66} σ $Cu^{65}(n, \gamma) Cu^{66}$ = 560 mb for therm. neutrons	Error contains : differences for several measurements ; neutron flux ; calibration	Element : 2.54 × 5.08 cm ; thickness : 0.0127 cm
29-63*a*5	D60 I	10 min	14.6	530 ± 26		cf. 8-16*b*5		Liquid scintillator Dioxane (201 gr) Naphthalene (14 gr) PPO (1 gr); H_2O (5 gr); $Cu(NO_3)_2 . 3H_2O$(0.967 gr)
29-63*a*6	P61 III	9.8 ± 0.2 min*[2]	14.1 ± 0.1	490 ± 45		cf. 13-27*b*8		
29-63*a*7	F60	—	13.77 ± 0.20*[3] 14.74 ± 0.27	378 ± 34 507 ± 45		cf. 7-14*a*7		
29-63*a*8	F50	10 min	14*[4]	330 ± 66	rel. : σ $D(d, n) He^3$	β-activity, geiger-counter. Calibration with Cu^{66} σ $Cu^{65}(n, \gamma) Cu^{66}$ = 560 mb for therm. neutrons	—	Element
29-63*a*9	B62 I	10.03 ± 0.03 min*[2]	14.1 ± 0.1*[5]	509 ± 56	rel. : cf. 26-56*b*4 $Fe^{56}(n, p) Mn^{56}$ = 112.5 mb		cf. 13-27*b*8	
29-63*a*10	S61 II	9.90 ± 0.04 min*[2]	14.1 ± 0.2	458 ± 10		cf. 13-27*b*11		

*[1] Also measured from threshold to 27 MeV
*[2] Measured by the authors
*[3] Also measured for 12.5 MeV ≤ E_n ≤ 18 MeV
*[4] Also measured from threshold to 14 MeV
*[5] Also measured for 13 MeV ≤ E_n ≤ 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX
29-63*a*11	G62	—	13.86 ± 0.10 14.11 ± 0.10 14.37 ± 0.15 14.59 ± 0.20 14.77 ± 0.25	424 ± 21 455 ± 23 488 ± 24 519 ± 26 550 ± 27	abs. for $E_n = 14.77$ MeV α from T(*d*, *n*) He^4	β^+ activity, 0.511 MeV annihilation radiation measured with 2 NaI crystals switched in coincidence	Standard deviation	Element, foils
29-63*a*12	M52		Relative measurement*1			β-activity, geiger counter	—	—
29-63*a*13	C56			cf. 12-24*b*8*2				

$Cu^{63}(n, p)\ Ni^{63} + Cu^{63}(n, pn)\ Ni^{62}$

29-63*d*1	A57 II	—	14.1	120 ± 24		cf. 13-27*d*1		
29-63*d*2 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^\circ} =$ *a*) 118 ± 9 *b*) 105 ± 10		cf. 11-23*d*1		
29-63*d*3 diff.	S60	—	14.1	$2\cdot\frac{d\sigma}{d\Omega} = 149 \pm 30$ for $d\Omega = 0^\circ - 180^\circ$		cf. 13-27*d*3		

$Cu^{63}(n, np)\ Ni^{62}$

29-63*e*1	A57 II	—	14.1	130 ± 26		cf. 13-27*d*1		
29-63*e*2 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^\circ} =$ 152 ± 30		cf. 11-23*d*1		

$Cu^{63}(n, He^3)\ Co^{61}$

29-63*f*1	B62 II	1.65*h*	14.7	< 0.08	—	—	—	—

*1 Measured for 12 MeV $\leq E_n \leq$ 18.5 MeV
*2 Measured for 12.5 MeV $\leq E_n \leq$ 17.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX
					$Cu^{63}(n, \alpha) Co^{60m}$			
29-63*i*1*m*	K62	10.4 min	14.8 ± 0.4	23 ± 3		cf. 15-31*a*4		
					$Cu^{65}(n, 2n) Cu^{64}$			
29-65*a*1	P53	12*h*	14.5 ± 0.35	1085 ± 175		cf. 7-14*a*1		Element
29-65*a*2	F52	12.8*h*	14.1	970 ± 80		cf. 13-27*b*2		
29-65*a*3	R58 I	13.4*h*	14	935		cf. 7-14*a*2		
29-65*a*4	P61 I	12.68*h**1	13.88 ± 0.10*2 14.01 ± 0.10 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31	879 ± 33 906 ± 36 892 ± 36 937 ± 37 953 ± 38 968 ± 39 975 ± 39		cf. 22-46*a*2		
29-65*a*5	P61 III	12.7 ± 0.15*h**1	14.1 ± 0.1	940 ± 85		cf. 13-27*b*8		
29-65*a*6	P59 I	12.85 ± 0.05*h**1	14.8 ± 0.8	954 ± 130		cf. 13-27*b*4		
29-65*a*7	R61 II	13.6 ± 0.5*h**1	14.4 ± 0.3	959 ± 79		cf. 7-14*a*7		Element
29-65*a*8	B61 IV	12.75 ± 0.04*h**1	14.1 ± 0.1*3	918 ± 80		cf. 13-27*b*8		
29-65*a*9	D60 II	—	15 ± 0.4	869 ± 100		cf. 26-56*b*11		
29-65*a*10	W60 II	12.87*h*	14.5 ± 0.5	1030 ± 95	rel. : cf. 29-63*a* $Cu^{63}(n, 2n)$ = 522 mb Sandwich-method	γ-activity. Measuring of the area under the photopeak with a 2 × 1 3/4″ NaI crystal; calibration with Co^{58} and Na^{22}	—	—
29-65*a*11	G62	—	14.77	995 ± 70		cf. 29-63*a*11		

*1 Measured by the author
*2 Also measured for 10 MeV $\leqq E_n \leqq$ 19.8 MeV
*3 Also measured for 13 MeV $\leqq E_n \leqq$ 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Cu^{65}(n, p)\ Ni^{65}$				
29-65*b*1	F52	2.56*h*	14.1	19 ± 4		cf. 13-27*b*2		Element ½″ ∅, thickness 120 mg/cm²
29-65*b*2	S59 I	2.56*h*	14.8 ± 0.8	31 ± 13		cf. 17-37*b*2		Element 9.5-12.7 mm ∅ thickness 45 mg/cm²
29-65*b*3	P59 I	2.55 ± 0.20*h**1	14.8 ± 0.8	27 ± 11		cf. 13-27*b*4		Element 1.7-2.1 cm ∅ thickness 3-6 mg/cm²
29-65*b*4	P61 III	2.6 ± 0.3*h**1	14.1 ± 0.1	29 ± 5		cf. 13-27*b*8		CuO, powder
29-65*b*5	M61 II	—	14.8	29 ± 3		cf. 11-23*i*2		
29-65*b*6	D60 II	—	15 ± 0.4	17 ± 4		cf. 26-56*b*7		
29-65*b*7	Z56	—	14.0	~20	—	—	—	—
29-65*b*8	B62 II	2.6*h*	14.7	29.3 ± 3.2	—	—	—	—
				$Cu^{65}(n, p)\ Ni^{65} + Cu^{65}(n, pn)\ Ni^{64}$				
29-65*d*1	A57 II	—	14.1	40 ± 8		cf. 12-37*d*1		
29-65*d*2 diff.	S60	—	14.1	$2 \cdot \frac{d\sigma}{d\Omega} = 30 \pm 6$ for $d\Omega = 0^{\circ}$— 180°		cf. 13-27*d*3		
				$Cu^{65}(n, \alpha)\ Co^{62g}$				
29-65*i*1*g*	K62	13.9 min	14.8 ± 0.4	7.5 ± 2		cf. 15-31*a*4		

*1 Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

$Cu^{65}(n, n\alpha)\ Co^{61}$

I	II	III	IV	V	VI	VII	VIII	IX
29-65*k*1	B62 I	99.6 ± 2 min*1	14.1 ± 0.1*2	5.8 ± 2		cf. 13-27*b*8		
29-65*k*2	K62	1.65*h*	14.8 ± 0.4	2.8 ± 0.3		cf. 15-31*a*4		
29-65*k*3	B62 II	1.6*h*	14.7	2.9 ± 0.8	—	—	—	—

$Cu^{nat}(n, 2n)\ Cu$

I	II	III	IV	V	VI	VII	VIII	IX
29-*a*1	A58 II	—	14.1	760 ± 60		cf. 1-2*a*1		Element

$Cu^{nat}(n, p + n, pn)\ Ni$

I	II	III	IV	V	VI	VII	VIII	IX
29-*d*1 diff.	A59	—	14.1	a) $4 \cdot \frac{d\sigma}{d\Omega} = 98$ for $d\Omega = 90^0 — 180^0$ b) $2 \cdot \frac{d\sigma}{d\Omega} = 118$ for $d\Omega = 0^0 — 180^0$		cf. 26-54*d*2		Element
29-*d*2 diff.	C59 I	—	14.5	$4\pi \left[\frac{d\sigma}{d0}\right] = 46 \pm 5$; means for $0 = 18^0$, 45^0, 90^0, 135^0 and $d0 = 18^0$	abs. : proton recoil telescope	Telescope, 2 prop. counters in coincidence with a CsI crystal and in anti-coincidence with a prop. counter before the target. Separation of *n,p*- and *n,np*-processes by stat. theory. σ probably contains *n, d*-processes	—	—

*1 Measured by the authors
*2 Also measured from threshold to 19.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX

$Cu^{nat}(n, np)$ Ni

I	II	III	IV	V	VI	VII	VIII	IX
29-*e*1 diff.	A59	—	14.1	128		cf. 26-54*d*2		Element
29-*e*2 diff.	C59 I	—	14.5	$4\pi\left[\frac{d\sigma}{d0}\right] = 181 \pm 18$, means for $0 = 18°$, 45°, 90°, 135° and *d*0 = 18°		cf. 29-*d*2		

ZINC

$Zn^{64}(n, 2n) Zn^{63}$

I	II	III	IV	V	VI	VII	VIII	IX
30-64*a*1	P53	38 min	14.5 ± 0.35	224 ± 45		cf. 7-14*a*1		Element
30-64*a*2	Y57	38.5 min	14.1 ± 0.15	119 ± 18		cf. 13-27*b*3		
30-64*a*3	P60 I	36 ± 0.2 min*¹	14.8 ± 0.9	254 ± 50		cf. 27-59*a*1*g*		Element, discs ; thickness 3-35 mg/cm²
30-64*a*4	R58 I	39.9 min	14	159		cf. 7-14*a*1		
30-64*a*5	R61 I	—	13.5	75		cf. 7-14*a*7		
30-64*a*5	R61 II	39.9 ± 0.8 min*¹	14.4 ± 0.3	167 ± 13		cf. 7-14*a*7		Element
30-64*a*6	G61 IV	—	14*² 14.5 15	120 ± 10 180 ± 15 230 ± 15	—	—	—	—
30-64*a*7	W62	38 min	13.86 ± 0.10 14.11 ± 0.10 14.37 ± 0.15 14.59 ± 0.20 14.77 ± 0.25	96 ± 8 107 ± 9 136 ± 11 165 ± 13 182 ± 15		cf. 29-63*a*11		
30-64*a*8	K60 II	38 min	Relative measurement*¹. Exp. curve was fitted by $\sigma = 167$ mb for $E_n = 14.4$ MeV (cf. 30-64*a*5)			β-activity, geiger counter	—	Element, nat ; thickness ≈ range of the β

$Zn^{64}(n, p) Cu^{64}$

I	II	III	IV	V	VI	VII	VIII	IX
30-64*b*1	P53	12*h*	14.5 ± 0.35	386 ± 58		cf. 7-14*a*1		Element
30-64*b*2	P60 I	13.0 ± 0.2*h**¹	14.8 ± 0.9	284 ± 20		cf. 27-59*a*1*g*		Element, discs ; thickness 3-35 mg/cm²

*¹ Measured by the authors
*² Also measured for 13 MeV $\leq E_n \leq$ 17.6 MeV

I	II	III	IV	V	VI	VII	VIII	IX
30-64*b*3	R61 I	—	13.5	215		cf. 30-64*b*3		
30-64*b*4	Z56	—	14.0	~216		cf. 30-66*b*4		
30-64*b*5	W62	12.85*h*	13.86 ± 0.10 14.11 ± 0.10 14.37 ± 0.15 14.59 ± 0.20 14.77 ± 0.25	190 ± 15 191 ± 15 177 ± 14 164 ± 13 155 ± 12		cf. 29-63*a*11		
30-64*b*6	G61 IV	—	14*[1] 14.25 14.5 14.75 ± 0.1 15 ± 0.1	220 ± 20 188 ± 15 220 ± 20 182 ± 16 196 ± 15	—	—	—	—
30-64*b*7	C56			cf. 12-24*b*8*[2]				

$Zn^{64}(n, p)\ Cu^{64} + Zn^{64}(n, pn)\ Cu^{63}$

I	II	III	IV	V	VI	VII	VIII	IX
30-64*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^o} =$ *a*) 179 ± 18 *b*) 171 ± 17		cf. 11-23*d*1		
30-64*d*2 diff.	S60	—	14.1	$2\cdot\frac{d\sigma}{d\Omega} = 257 \pm 50$ for $d\Omega = 0^o$—180^o		cf. 13-27*d*3		
30-64*d*3 diff.	R56 II	—	14	~295	—	Nuclear plate	—	—

$Zn^{64}(n, np)\ Cu^{63}$

I	II	III	IV	V	VI	VII	VIII	IX
30-64*e*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^o} =$ 281 ± 18		cf. 11-23*d*1		

*[1] Also measured for 12.4 MeV $\leq E_n \leq$ 17.5 MeV
*[2] Measured for 12.5 MeV $\leq E_n \leq$ 17.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Zn^{66}(n, 2n)\ Zn^{65}$				
30-66*a*1	H62 I	—	14.9	530 ± 130	cf. 20-48*a*1	K-electron capture in prop. counter	cf. 20-48*a*1	
				$Zn^{66}(n, p)\ Cu^{66}$				
30-66*b*1	P53	5 min	14.5 ± 0.35	101 ± 17		cf. 7-14*a*1		Element
30-66*b*2	Y57	5.13 min	14.1 ± 0.15	60.2 ± 7.2		cf. 13-27*b*3		
30-66*b*3	P60 I	5.2 ± 0.3 min*	14.8 ± 0.9	77 ± 10		cf. 27-59*a*1*g*		cf. 30-64*b*2
30-66*b*4	Z56	—	—	~80	—	—	—	—
				$Zn^{66}(n, p)\ Cu^{66} + Zn^{66}(n, pn)\ Cu^{65}$				
30-66*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^{\circ}} =$ *a*) 34 ± 4 *b*) 35 ± 4		cf. 11-23*d*1		
				$Zn^{66}(n, np)\ Cu^{65}$				
30-66*e*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^{\circ}} =$ 50 ± 4		cf. 11-23*d*1		
				$Zn^{67}(n, p)\ Cu^{67} + Zn^{67}(n, pn)\ Cu^{66}$				
30-67*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^{\circ}} =$ *a*) 41 ± 7 *b*) 33 ± 7		cf. 11-23*d*1		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
					$Zn^{68}(n, p)\ Cu^{68}$			
30 68*b*1	P60 I	36 ± 5 sec*	14.8 ± 0.9	25 ± 10		cf. 27-59*a*1*g*		cf. 30-64*b*2
					$Zn^{68}(n, \alpha)\ Ni^{65}$			
30-68*i*1	P60 I	2.25 ± 0.02*h**	14.8 ± 0.9	51 ± 10		cf. 27-59*a*1*g*		cf. 30-64*b*2
30-68*i*2	B55 III	2.56*h*	14.05 ± 0.55	7.6 ± 0.8		cf. 27-59*i*3		
					$Zn^{70}(n, n'\alpha)\ Ni^{66}$			
30-68*k*1	B62 II	55*h*	14.7	0.89 ± 0.40				
					$Zn^{nat}(n, p + n, pn + n, np + n, d)\ Cu$			
30-*g*1 diff.	H62 III	—	14.4 ± 0.2	170 ± 20 for E_p > 2.2 MeV		cf. 12-*d*1		

* Measured by the authors

GALLIUM

$Ga^{69}(n, 2n)\ Ga^{68}$

I	II	III	IV	V	VI	VII	VIII	IX
31-69*a*1	P53	68 min	14.5 ± 0.35	552 ± 155		cf. 7-14*a*1		Element
31-69*a*2	R58 I	69.2 min	14	1089		cf. 7-14*a*2		
31-69*a*3	R61 II	69.2 ± 1.4 min*1	14.4 ± 0.3	923 ± 70		cf. 7-14*a*7		Element
31-69*a*4	K61 II	67.5 min	14.8 ± 0.5	1070 ± 107		cf. 17-35*a*5*m*		

$Ga^{69}(n, p)\ Zn^{69m}$

I	II	III	IV	V	VI	VII	VIII	IX
31-69*b*1*m*	P53	14*h*	14.5 ± 0.35	24.4 ± 20		cf. 7-14*a*1		Element
31-69*b*2*m*	B62 I	13.8*h*	15 ± 0.5*2	42 ± 4	rel. : cf. 13-27*i* $Al^{27}(n, \alpha)$ = 118 mb	cf. 13-27*b*8		

$Ga^{69}(n, \alpha)\ Cu^{66}$

I	II	III	IV	V	VI	VII	VIII	IX
31-69*i*1	P53	5 min	14.5 ± 0.35	105 ± 58		cf. 7-14*a*1		

$Ga^{71}(n, 2n)\ Ga^{70}$

I	II	III	IV	V	VI	VII	VIII	IX
31-71*a*1	P53	20 min	14.5 ± 0.35	700 ± 100		cf. 7-14*a*1		Element
31-71*a*2	K61 II	21.0 min	14.8 ± 0.5	2180 ± 218		cf. 17-35*a*5*m*		

$Ga^{71}(n, n\alpha)\ Cu^{67}$

I	II	III	IV	V	VI	VII	VIII	IX
31-71*k*1	B62 I	59.6 ± 0.6*h**1	15.2 ± 0.5	6 ± 2*3	rel. : cf. 13-27*i* $Al^{27}(n, \alpha)$ = 118 mb		cf. 13-27*b*8	
31-71*k*2	B62 II	61*h*	14.7	2 ± 1	—	—	—	—

*1 Measured by the authors
*2 Also measured for 15 MeV ≦ En ≦ 19.6 MeV
*3 Also measured for 15.2 MeV ≦ E_n ≦ 19.6 MeV

GERMANIUM

I	II	III	IV	V	VI	VII	VIII	IX
				$Ge^{70}(n, 2n)\ Ge^{69}$				
32-70a1	P53	40h	14.5 ± 0.35	666 ± 230		cf. 7-14a1		Element
32-70a2	R59 I	36.9h	14	604 ± 48		cf. 17-35a3m		
32-70a3	R61 II	38.6 ± 0.8h*1	14.4 ± 0.3	598 ± 45		cf. 7-14a7		GeO_2
32-70a4	P61 I	40.4h	13.83 ± 0.10*2 14.01 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.83 ± 0.31 14.93 ± 0.36	509 ± 15 508 ± 15 607 ± 18 621 ± 19 664 ± 20 716 ± 21 681 ± 20		cf. 22-46a2		
32-70a5	K61 II	41.0h	14.8 ± 0.5	1600 ± 240		cf. 17-35a5m		
				$Ge^{70}(n, p)\ Ga^{70}$				
32-70b1	P53	20 min	14.5 ± 0.35	129 ± 60		cf. 7-14a1		Element
32-70b2	Z56	—	—	~93	—	—	—	—
				$Ge^{72}(n, p)\ Ga^{72}$				
32-72b1	P53	14h	14.5 ± 0.35	65.2 ± 26		cf. 7-14a1		Element
32-72b2	Z56	—	—	~32	—	—	—	—
				$Ga^{73}(n, p)\ Ga^{73}$				
32-73b1	P53	5h	14.5 + 0.35	136.6 ± 70		cf. 7-14a1	—	Element

*1 Measured by the authors
*2 Also measured for 11.8 MeV ≦ E_n ≦ 19.7 MeV

I	II	III	IV	V	VI	VII	VIII	IX
					$Ge^{71}(n, \alpha)\ Zn^{71}$			
32-74*i*1	P53	2.2 min	14.5 ± 0.35	14.9 ± 6		cf. 7-14*a*1	—	Element
					$Ge^{76}(n, 2n)\ Ge^{75}$			
32-76*a*1	P53	82 min	14.5 ± 0.35	1820 ± 550		cf. 7-14*a*1		Element
32-76*a*2	K61 II	78 min	14.8 ± 0.5	1200 ± 240		cf. 17-35*a*3*m*		
					$Ge^{76}(n, n\alpha)\ Zn^{72}$			
32-76*k*1	B62 II	49*h*	14.7	< 2	—	—	—	—

ARSENIC

$As^{75}(n, 2n) As^{74}$

I	II	III	IV	V	VI	VII	VIII	IX
33-75*a*1	P61 I	17.8*1	14.01 ± 0.10*2	1070 ± 43		cf. 22-46*a*2		
			14.31 ± 0.13	1113 ± 45				
			14.68 ± 0.26	1149 ± 46				
			14.93 ± 0.36	1123 ± 45				
33-75*a*2	P53	17*d*	14.5 ± 0.35	545 ± 160		cf. 7-14*a*1		Element

$As^{75}(n, p) Ge^{75}$

I	II	III	IV	V	VI	VII	VIII	IX
33-75*b*1	P61 IV	—	14.01 ± 0.10*3	20.7 ± 1.5		cf. 22-46*a*2		
			14.31 ± 0.13	19.3 ± 1.4				
			14.54 ± 0.20	18.1 ± 1.3				
			14.93 ± 0.36	15.9 ± 1.2				
33-75*b*2	P53	8.2 min	14.5 ± 0.35	11.8 ± 2.4		cf. 7-14*a*1		Element

$As^{75}(n, p) Ge^{75g}$

I	II	III	IV	V	VI	VII	VIII	IX
33-75*b*1*g*	F61 II	—	14.1 ± 0.2	25 ± 5		cf. 13-27*b*12		

$As^{75}(n, p) Ge^{75m}$

I	II	III	IV	V	VI	VII	VIII	IX
33-75*b*1*m*	F61 II	—	14.1 ± 0.2	10 ± 2		cf. 13-27*b*12		

$As^{75}(n, p) Ge^{75} + As^{75}(n, pn) Ge^{74}$

I	II	III	IV	V	VI	VII	VIII	IX
33-75*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^0} =$ 27 ± 5		cf. 11-23*d*1		

*1 Measured by the authors
*2 Also measured for 10.3 MeV $\leqq E_n \leqq$ 19.8 MeV
*3 Also measured for 7 MeV $\leqq E_n \leqq$ 14.9 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$As^{75}(n, He^3)\,Ga^{73}$				
33-75*f*1	B62 II	5*h*	14.7	< 0.51	—	—	—	—
				$As^{75}(n, p)\,Ge^{75} + As^{75}(n, pn + n, np + n, d)\,Ge^{74}$				
33-75*g*1	A58 III	—	14	115 ± 15		cf. 25-55*g*1		
				$As^{75}(n, 2p)\,Ga^{74}$				
33-75*h*1	B62 II	7.8 min	14.7	< 0.50	—	—	—	—
				$As^{75}(n, \alpha)\,Ga^{72}$				
33-75*i*1	P53	14*h*	14.5 ± 0.35	12.3 ± 2.2		cf. 7-14*a*1		Element
33-75*i*2	P61 IV	—	14.01 ± 0.10* 14.31 ± 0.13 14.68 ± 0.23 14.93 ± 0.36	9.8 ± 0.7 10.4 ± 0.7 10.2 ± 0.7 10.0 ± 0.7		cf. 22-46*a*2		
33-75*i*3	F61 I	—	14.8	4.59	—	—	—	—
33-75*i*4	P62	14*h*	14.7	9.3 ± 3.1	—	—	—	—

* Also measured for 7 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX

SELENIUM

$Se^{80}(n, \alpha) Ge^{77}$

I	II	III	IV	V	VI	VII	VIII	IX
34-80*i*1	P53	59 sec ; 12 *h*	14.5 ± 0.35	37.7 ± 15.4		cf. 7-14*a*1		Element

$Se^{82}(n, 2n) Se^{81}$

I	II	III	IV	V	VI	VII	VIII	IX
34-82*a*1	P53	59 min	14.5 ± 0.35	1500 ± 500		cf. 7-14*a*1		Element

BROMINE

$Br^{79}(n, 2n) Br^{78}$

I	II	III	IV	V	VI	VII	VIII	IX
35-79*a*1	P53	6.4 min	14.5 ± 0.35	1141 ± 285		cf. 7-14*a*1		LiBr; NaBr
35-79*a*2	R59 I	6.3 min	14	788 ± 63		cf. 17-35*a*3*m*		
35-79*a*3	R61 II	6.33 ± 0.13 min*	14.4 ± 0.3	835 ± 63		cf. 7-14*a*7		NaBr

$Br^{79}(n, \alpha) As^{76}$

I	II	III	IV	V	VI	VII	VIII	IX
35-79*i*1	B58	26.8*h*	14.05 ± 0.55	10 ± 1.8		cf. 27-59*i*3		
35-79*i*2	P62	27*h*	14.7	10.8 ± 2.4	—	—	—	—

$Br^{81}(n, 2n) Br^{80}$ - tot.

I	II	III	IV	V	VI	VII	VIII	IX
35-81*a*1*t*	S62	—	$14.6^{+0.2}_{-0.3}$	1047 ± 98		cf. 37-87*a*1		

$Br^{81}(n, 2n) Br^{80m}$

I	II	III	IV	V	VI	VII	VIII	IX
35-81*a*1*m*	P53	4.4*h*	14.5 ± 0.35	828 ± 165		cf. 7-14*a*1		LiBr; NaBr
35-81*a*2*m*	S62	—	$14.6^{+0.2}_{-0.3}$	610 ± 93		cf. 37-87*a*1		
35-81*a*3*m*	R61 II	4.49 ± 0.09*h**	14.4 ± 0.3	752 ± 72		cf. 7-14*a*7		NaBr
35-81*a*4*m*	F61 II	—	14.2 ± 0.2	510 ± 56		cf. 13-27*b*12		

$Br^{81}(n, 2n) Br^{80g}$

I	II	III	IV	V	VI	VII	VIII	IX
35-81*a*1*g*	S62	—	$14.6^{+0.2}_{-0.3}$	437 ± 29		cf. 37-87*a*1		
35-81*a*2*g*	F61 II	—	14.2 ± 0.2	470 ± 50		cf. 13-27*b*12		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
				$Br^{81}(n, p)\ Se^{81}$ - tot.				
35-81*b*1*t*	S62	—	$14.6 {+0.2 \atop -0.3}$	57 ± 10		cf. 38-86*b*2		
				$Br^{81}(n, p)\ Se^{81m}$				
35-81*b*1*m*	S62	—	$14.6 {+0.2 \atop -0.3}$	32 ± 8		cf. 38-86*b*2		
				$Br^{81}(n, p)\ Se^{81g}$				
35-81*b*1*g*	S62	—	$14.6 {+0.2 \atop -0.3}$	25 ± 5		cf. 38-86*b*2		
				$Br^{81}(n, \alpha)\ As^{78}$				
35-81*i*1	P53	90 min	14.5 ± 0.35	103 ± 20		cf. 7-14*a*1		LiBr, NaBr
35-81*i*2	S62	—	$14.6 {+0.2 \atop -0.3}$	107 ± 20		cf. 38-86*b*2		
35-81*i*3	P62	90 min	14.7	9.2 ± 1.2	—	—	—	—
				$Br^{81}(n, n\alpha)\ As^{77}$				
35-81*k*1	B62 II	39*h*	14.7	<1.0	—	—	—	—
				$Br^{nat}(n, p + n, pn)\ Se$				
35-*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta}\right]_{125^0} =$ < 14		cf. 11-23*d*1		

I	II	III	IV	V	VI	VII	VIII	IX

RUBIDIUM

$Rb^{85}(n, 2n)\ Rb^{84}$

I	II	III	IV	V	VI	VII	VIII	IX
37-85*a*1	S62	—	$14.6^{+0.2}_{-0.3}$	687 ± 74		cf. 37-87*a*1		

$Rb^{85}(n, 2n)\ Rb^{84} + Rb^{85}(n, 2n)\ Rb^{84m}$

I	II	III	IV	V	VI	VII	VIII	IX
37-85*a*1+*m*	P61 I	33*d*	14.09 ± 0.10*1 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31	1447 ± 72 1498 ± 75 1520 ± 76 1530 ± 77	σ does not contain the decay of Rb^{84m} by E. C.	cf. 22-46*a*2		

$Rb^{85}(n, \alpha)\ Br^{82}$

I	II	III	IV	V	VI	VII	VIII	IX
37-85*i*1	S62	—	$14.6^{+0.2}_{-0.3}$	143 ± 9		cf. 38-68*b*2		
37-85*i*2	P62	36*h*	14.7	145	—	—	—	—

$Rb^{87}(n, 2n)\ Rb^{86}$

I	II	III	IV	V	VI	VII	VIII	IX
37-87*a*1	S62	—	$14.6^{+0.2}_{-0.3}$	835 ± 136	rel.: cf. 26-56*b* $Fe^{56}(n, p)$ = 110 mb or cf. 13-27*i* $Al^{27}(n, \alpha)$ = 115 mb Sandwich method	β- and γ-activity. Corrections for abs. β-counting cf. R56 III and Z50. γ-rays were counted with a 3 × 3″ NaI crystal; efficiency cf. L56. Chem. separation	Total error, without deviations in the decay scheme	Foils

$Rb^{87}(n, 2n)\ Rb^{86} + R^{87}(n, 2n)\ Rb^{86m}$

I	II	III	IV	V	VI	VII	VIII	IX
37-87*a*1+*m*	P61 I	18.66*d*	14.09 ± 0.10*2 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31	1170 ± 57 1210 ± 61 1194 ± 59 1191 ± 59	σ does not contain the decay of Rb^{86m} by E. C.	cf. 22-46*a*2		

*1 Also measured for 10.5 MeV $\leq E_n \leq$ 19.6 MeV

*2 Also measured for 10.0 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Rb^{87}(n, \alpha) Br^{84}$				
37-87*i*1	P53	33 min	14.5 ± 0.35	38.9 ± 16.3		cf. 7-14*a*1		Rb_2CO_3
37-87*i*2	S62	—	$14.6^{+0.2}_{-0.3}$	59 ± 12		cf. 38-86*b*2		
				$Rb^{87}(n, n\alpha) Br^{83}$				
37-87*k*1	B62 II	2.3*h*	14.7	< 1.5	—	—	—	—

I	II	III	IV	V	VI	VII	VIII	IX

STRONTIUM

$Sr^{84}(n, 2n) Sr^{83}$

I	II	III	IV	V	VI	VII	VIII	IX
38-84*a*1	P61 I	33*h*	13.88 ± 0.10* 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.28 14.93 ± 0.36	115.9 ± 5.8 142.4 ± 7.1 149.9 ± 7.5 171.7 ± 8.6 176.8 ± 8.8 180.6 ± 9.0		cf. 22-46*a*2		
38-84*a*2	S62	—	$14.6^{+0.2}_{-0.3}$	380 ± 50	rel. : cf. 26-56*b* $Fe^{56}(n, p)$ = 110 mb or cf. 13-27*i* $Al^{27}(n, \alpha)$ = 115 mb Sandwich method	γ-activity; 3 × 3″ NaI crystal. Efficiency cf. L56	Total error without deviations in the decay scheme	Foils
38-84*a*3	K61 II	33*h*	14.8 ± 0.5	1770 ± 180		cf. 17-35*a*5*m*		
38-84*a*4	P62	33*h*	14.7	140 ± 80	—	—	—	—

$Sr^{86}(n, 2n) Sr^{85g}$

I	II	III	IV	V	VI	VII	VIII	IX
38-86*a*1*g*	M61 I	65*d*	14.1	680 ± 109		cf. 38-86*a*1*m*		
38-86*a*2*g*	S62	—	$14.6^{+0.2}_{-0.3}$	280 ± 10		cf. 38-84*a*2		

$Sr^{86}(n, 2n) Sr^{85m}$

I	II	III	IV	V	VI	VII	VIII	IX
38-86*a*1*m*	M61 I	70 min	14.1	21 ± 8	rel. : cf. 13-27*i*10 $Al^{27}(n, \alpha)$ = 116 mb	γ-activity. 1 ½ × 1″ NaI-crystal. Efficiency cf. K54. Corrections for geometry, backscattering etc. exp. determinated	Total error	$SrCO_3$ powder
38-86*a*2*m*	S62	—	$14.6^{+0.2}_{-0.3}$	312 ± 50		cf. 38-84*a*2		

* Also measured for 12 MeV $\leq E_n \leq$ 19.8 MeV

$Sr^{86}(n, p)\,Rb^{86}$

I	II	III	IV	V	VI	VII	VIII	IX
38-86*b*1	P61 IV	—	14.01 ± 0.10* 14.31 ± 0.13 14.68 ± 0.26 14.93 ± 0.36	42.5 ± 4.0 43.5 ± 4.4 41.5 ± 3.7 45.3 ± 4.0		cf. 22-46*a*2		
38-86*b*2	S62	—	$14.6^{+0.2}_{-0.3}$	64 ± 7	rel. : cf. 26-56*b* $Fe^{56}(n, p)$ = 110 mb or cf. 13-27*i* $Al^{27}(n, \alpha)$ — 115 mb Sandwich method	β-activity. Corrections for abs. β-counting cf. R56III and Z50. Chem. separation	Total error without deviations in the decay scheme	Foils

$Sr^{88}(n, 2n)\,Sr^{87}$

I	II	III	IV	V	VI	VII	VIII	IX
38-88*a*1	S62	—	$14.6^{+0.2}_{-0.3}$	215 ± 24		cf. 38-84*a*2		

$Sr^{88}(n, p)\,Rb^{88}$

I	II	III	IV	V	VI	VII	VIII	IX
38-88*b*1	P53	17 min	14.5 ± 0.35	17.7 ± 3.5		cf. 7-14*a*1		$SrCO_3$
38-88*b*2	S62	—	$14.6^{+0.2}_{-0.3}$	30 ± 2		cf. 38-86*b*2		
38-88*b*3	B62 II	18 min	14.7	11 ± 3	—	—	—	—

$Sr^{88}(n, \alpha)\,Kr^{85m}$

I	II	III	IV	V	VI	VII	VIII	IX
38-88*i*1*m*	P53	4.5*h*	14.5 ± 0.35	64 ± 20		cf. 7-14*a*1		$SrCO_3$
38-88*i*2*m*	S62	—	$14.6^{+0.2}_{-0.3}$	87 ± 31		cf. 38-86*b*2		

$Sr^{nat}(n, p)\,Rb + Sr^{nat}(n, pn)\,Rb$

I	II	III	IV	V	VI	VII	VIII	IX
38-*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^0} =$ 22 ± 17		cf. 11-23*d*1		

* Also measured for 13.4 MeV $\leq E_n \leq$ 14.93 MeV

YTTRIUM

$Y^{89}(n, 2n) Y^{88}$

I	II	III	IV	V	VI	VII	VIII	IX
39-89*a*1	M61 I	—	14.1	540 ± 80		cf. 38-86*a*1*m*		
39-89*a*2	T60	—	13.9*[1]	585	—	—	—	—
			14.0	680				
			14.6	685				
			15.1	1005				
39-89*a*3	S62	—	$14.6^{+0.2}_{-0.3}$	542 ± 58		cf. 38-84*a*2		
39-89*a*4	P61 IV		Relative measurement*[2]			cf. 22-46*a*2		

$Y^{89}(n, 2n) Y^{88m}$

I	II	III	IV	V	VI	VII	VIII	IX
39-89*a*1*m*	G61 I	14 ± 1 msec*[3]	14.5	> 400		cf. 49-115*a*1*m*		

$Y^{89}(n, p) Sr^{89}$

I	II	III	IV	V	VI	VII	VIII	IX
39-89*b*1	P61 IV	—	14.01 ± 0.10*[4]	23.7 ± 1.7		cf. 22-46*a*2		
			14.09 ± 0.10	22.7 ± 1.6				
			14.31 ± 0.13	24.1 ± 1.7				
			14.54 ± 0.20	24.0 ± 1.7				
			14.68 ± 0.26	24.5 ± 1.8				
			14.81 ± 0.31	23.4 ± 1.7				
			14.93 ± 0.36	23.2 ± 1.7				
39-89*b*2	T60	—	13.9*[5]	14 ± 3	—	—	—	—
			14.0	14.5 ± 3				

*[1] Also measured for 12.2 MeV $\leq E_n \leq$ 15.1 MeV
*[2] Measured for 11.5 MeV $\leq E_n \leq$ 19.8 MeV
*[3] Measured by the authors
*[4] Also measured for 7 MeV $\leq E_n \leq$ 19.8 MeV
*[5] Also measured for 8.2 MeV $\leq E_n \leq$ 14.0 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Y^{89}(n, 2n)\ Rb^{88}$				
39-89*h*1	B62 II	18 min	14.7	< 0.020	—	—	—	—
				$Y^{89}(n, \alpha)\ Rb^{86}$				
39-89*i*1	P53	19*d*	14.5 ± 0.35	69.7 ± 42		cf. 7-14*a*1		
39-89*i*2	P61 IV	—	14.01 ± 0.10*1	5.0 ± 0.5		cf. 22-46*a*2		
			14.31 ± 0.13	5.5 ± 0.5				
			14.50 ± 0.20	5.0 ± 0.5				
			14.81 ± 0.31	5.4 ± 0.5				
39-89*i*3	S62	—	$14.6^{+0.2}_{-0.3}$	96 ± 24		cf. 38-86*b*2		
39-89*i*4	T60	—	13.9*2	1.6 ± 0.3	—	—	—	—
			14.0	2.0 ± 0.3				

*1 Also measured for 13.4 MeV $\leq E_n \leq$ 14.8 MeV
*2 Also measured for 8.2 MeV $\leq E_n \leq$ 14.0 MeV

ZIRCONIUM

$Zr^{90}(n, 2n)\ Zr^{89}$

I	II	III	IV	V	VI	VII	VIII	IX
40-90*a*1	P61 I	79.3*h*	13.88 ± 0.10*1 14.01 ± 0.10 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31 14.93 ± 0.36	585 ± 18 604 ± 18 623 ± 19 716 ± 21 768 ± 23 822 ± 25 838 ± 25 856 ± 26		cf. 22-46*a*2		
40-90*a*2	S62	—	$14.6^{+0.2}_{-0.3}$	502 ± 36		cf. 38-84*a*2		
40-90*a*3	R60	—	14.1	470 ± 22	—	Scintillation counter	—	—

$Zr^{90}(n, 2n)\ Zr^{89m}$

I	II	III	IV	V	VI	VII	VIII	IX
40-90*a*1*m*	P53	4.5 min	14.5 ± 0.35	> 79.8 ± 40		cf. 7-14*a*1		$Zr(NO_3)_2$. Element
40-90*a*2*m*	P62	4.4 min	14.7	84	—	—	—	—
40-90*a*3*m*	R60	—	14.1	74 ± 3		cf. 40-90*a*3		

$Zr^{90}(n, 2n)\ Zr^{89} + Zr^{90}(n, 2n)\ Zr^{89m}$

I	II	III	IV	V	VI	VII	VIII	IX
40-90*a*1+*m*	R61 II	79.4 ± 1.6*h**2	14.4 ± 0.3	677 ± 51		cf. 7-14*a*7		
40-90*a*2+*m*	R60	—	14.1	544 ± 22		cf. 40-90*a*3		

$Zr^{90}(n, p)\ Y^{90}$

I	II	III	IV	V	VI	VII	VIII	IX
40-90*b*1	P53	61*h*	14.5 ± 0.35	247 ± 100		cf. 7-14*a*1		$Zr(NO_3)_2$. Element

*1 Also measured for 12 MeV $\leq E_n \leq$ 19.8 MeV
*2 Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
40-90*b*2	P61 IV	—	14.01 ± 0.10*[1]	45 ± 2.5		cf. 22-46*a*2		
			14.09 ± 0.10	44.5 ± 2.5				
			14.31 ± 0.13	48 ± 2.5				
			14.50 ± 0.20	46.5 ± 2.5				
			14.68 ± 0.26	45 ± 2.0				
			14.81 ± 0.31	45 ± 2.0				
			14.93 ± 0.36	44.5 ± 2.0				
40-90*b*3	S62	—	$14.6^{+0.2}_{-0.3}$	233 ± 29		cf. 38-86*b*2		
40-90*b*4	R60	—	14.1	43.1 ± 2.0		cf. 40-90*a*3		

$Zr^{90}(n, \alpha)\ Sr^{87m}$

I	II	III	IV	V	VI	VII	VIII	IX
40-90*i*1*m*	P53	2.75*h*	14.5 ± 0.35	194 ± 110		cf. 7-14*a*1		Element
40-90*i*2*m*	B55 III	2.80*h*	14.05 ± 0.55	3.3 ± 0.6		cf. 27-59*i*3		
40-90*i*3*m*	B55 II	—	14.1	3.1 ± 0.2		cf. 29-63*a*4		
40-90*i*4*m*	R60	—	14.1	3.34 ± 0.16		cf. 40-90*a*3		
40-90*i*5*m*	P62	2.8*h*	14.7	2.8 ± 0.16	—	—	—	—

$Zr^{91}(n, p)\ Y^{91g}$

I	II	III	IV	V	VI	VII	VIII	IX
40-91*b*1*g*	R60	—	14.1	14.2 ± 1.4		cf. 40-90*a*3		

$Zr^{91}(n, p)\ Y^{91m}$

I	II	III	IV	V	VI	VII	VIII	IX
40-91*b*1*m*	R60	—	14.1	17.5 ± 0.8		cf. 40-90*a*3		

$Zr^{91}(n, p)\ Y^{91}$ - tot.

I	II	III	IV	V	VI	VII	VIII	IX
40-91*b*1*t*	S62	—	$14.6^{+0.2}_{-0.3}$	180 ± 43		cf. 38-86*b*2		

*[1] Also measured for 8 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
40-91*b*2*t*	B61 IV	—	14.8	~171	—	—	—	—
40-91*b*3*t*	S59 III	—	14.1	32	—	—	—	—
40-91*b*4*t*	R60	—	14.1	31.7 ± 1.4		cf. 40-90*a*3		

$Zr^{92}(n, p)\ Y^{92}$

I	II	III	IV	V	VI	VII	VIII	IX
40-92*b*1	S62	—	$14.6^{+0.2}_{-0.3}$	76 ± 16		cf. 38-86*b*2		
40-92*b*2	B62 II	—	14.7	22 ± 4	—	—	—	—
40-92*b*3	R60	—	14.1	20.7 ± 0.9		cf. 40-90*a*3		

$Zr^{92}(n, \alpha)\ Sr^{89}$

I	II	III	IV	V	VI	VII	VIII	IX
40-92*i*1	P61 IV	—	14.01 ± 0.10* 14.31 ± 0.13 14.68 ± 0.26 14.93 ± 0.36	9.5 ± 0.40 9.95 ± 0.45 10.3 ± 0.46 10.2 ± 0.46		cf. 22-46*a*2		
40-92*i*2	R60	—	14.1	21.8 ± 1.7		cf. 40-90*a*3		

$Zr^{94}(n, p)\ Y^{94}$

I	II	III	IV	V	VI	VII	VIII	IX
40-94*b*1	P53	16.5 min	14.5 ± 0.35	10.6 ± 4.2		cf. 7-14*a*1		$Zr(NO_3)_2$. Element
40-94*b*2	S62	—	$14.6^{+0.2}_{-0.3}$	48 ± 12		cf. 38-86*b*2		
40-94*b*3	S59 III	—	14.1	~11	—	—	—	—
40-94*b*4	B62 II	17 min	14.7	7 ± 4	—	—	—	—
40-94*b*5	R60	—	14.1	10.8 ± 0.6		cf. 40-93*a*3		

* Also measured for 13.4 MeV $\leqq E_n \leqq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Zr^{94}(n, pn + n, np + n, d)\ Y^{93}$				
40-94*c*1	R60	—	14.1	$< 0.8 \pm 0.1$		cf. 40-90*a*3		
				$Zr^{94}(n, \alpha)\ Sr^{91}$				
40-94*i*1	B55 III	9.7*h*	14.05 ± 0.55	3.6 ± 0.5		cf. 27-59*i*3		
40-94*i*2	B55 II	—	14.1	4.9 ± 0.5		cf. 29-63		
40-94*i*3	P61 IV	—	13.88 ± 0.10* 14.01 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.93 ± 0.36	5.0 ± 0.4 5.1 ± 0.4 5.7 ± 0.4 5.5 ± 0.4 6.0 ± 0.4 6.2 ± 0.4		cf. 22-46*a*2		
40-94*i*4	R60	—	14.1	3.99 ± 0.16		cf. 40-90*a*3		
40-94*i*5	P62	9.7*h*	14.7	4.3 ± 1.1	—	—	—	—
				$Zr^{96}(n, p)\ Y^{96}$				
40-96*b*1	B61 VI	—	14.8	< 5	—	—	—	—
				$Zr^{96}(n, \alpha)\ Sr^{93}$				
40-96*i*1	R60	—	14.1	$< 4.8 \pm 0.7$		cf. 40-93*a*3		
40-96*i*2	P62	7 min	14.7	5 ± 4	—	—	—	—
				$Zr^{nat}(n, 2n)\ Zr$				
40-*a*1	S57	—	14.1	610 ± 100 for $E_n > 0.5$ MeV $d\Omega = 4\pi$	abs.: α-from $T(d, n)\ He^4$	Nuclear plates; plates cyl. arranged around cyl. target; recoil protons recorded. Plates shielded by a Fe-paraffin collimator	Estimated mean total error	Element, cylinder: 1 ½″ ⌀; 1 ½″ height

* Also measured for $12.1\ \text{MeV} \leq E_n \leq 19.8\ \text{MeV}$

I	II	III	IV	V	VI	VII	VIII	IX

$Zr^{nat}(n, p + n, pn)\ Y$

I	II	III	IV	V	VI	VII	VIII	IX
40-*d*1 **diff.**	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^{\circ}} =$ 63 ± 12		cf. 11-23*d*1		

NIOBIUM

$Nb^{93}(n, 2n)\,Nb^{92g}$

I	II	III	IV	V	VI	VII	VIII	IX
41-93*a*1*g*	G61 I	10.0 ± 0.3*d**1	14.5	560 ± 62		cf. 49-115*a*1*m*		
41-93*a*2*g*	M61 I	9.9 ± 0.1*d**1	14.1	430 ± 70		cf. 38-86*a*1*m*		Powder Nb_2O_5
41-93*a*3*g*	B62 III	10.1*d*	14.5 ± 0.9	499 ± 91	rel. : cf. 29-63*a*3 $Cu^{63}(n, 2n)$ = 556 mb cf. 29-65*a*6 $Cu^{65}(n, 2n)$ = 954 mb; cf. 13-27*b*4 $Al^{27}(n, \alpha)$ = 114 mb Sandwich method	γ-activity. 3 × 3″ NaI crystal : measuring of the area under the photopeak	Probable total error	Powder
41-93*a*4*g*	P61 IV	—	Rel. measurement*2			cf. 22-46*a*2		
41-93*a*5*g*	T60	—	13.9*3 14.0 14.6 15.1	385 395 410 420	—	—	—	—

$Nb^{93}(n, 2n)\,Nb^{92m}$

I	II	III	IV	V	VI	VII	VIII	IX
41-93*a*1*m*	S62	—	$14.6^{+0.2}_{-0.3}$	318 ± 18		cf. 38-84*a*2		
41-93*a*2*m*	B62 III	13*h*	14.5 ± 0.9	< 1.2		cf. 41-93*a*3*g*		

$Nb^{93}(n, He^3)\,Y^{91m}$

I	II	III	IV	V	VI	VII	VIII	IX
41-93*f*1*m*	B62 II	51 min	14.7	< 0.06	—	—	—	—

*1 Measured by the authors
*2 Measured for 8.9 MeV $\leq E_n \leq$ 14.7 MeV
*3 Also measured for 9.9 MeV $\leq E_n \leq$ 15.1 MeV

I	II	III	IV	V	VI	VII	VIII	IX
					$Nb^{93}(n, p)\, Zr^{93} + Nb^{93}(n, pn + n, np + n, d)\, Zr^{92}$			
41-93*g*1 diff.	V57	—	14	$4\pi\left[\frac{d\sigma}{d\Omega}\right] = 22 \pm 8$ means for θ = 30°, 45°, 60°, 120°, 135°, 150° and Ep>6 MeV		cf. 12-*g*1		
					$Nb^{93}(n, 2p)\, Y^{92}$			
41-93*h*1	B62 II	3.7*h*	14.7	< 0.50	—	—	—	—
					$Nb^{93}(n, \alpha)\, Y^{90g}$			
41-93*i*1*g*	B62 III	64*h*	14.5 ± 0.9	8.6 ± 2.5	cf. 41-93*a*3*g*	cf. 13-27*b*4	cf. 41-93*a*3*g*	
					$Nb^{93}(n, \alpha)\, Y^{90m}$			
41-93*i*1*m*	B62 III	3.02*h*	14.5 ± 0.9	5.9 ± 2	cf. 41-93*a*3*g*	β+γ-activity. β : cf. 13-27*b*4 γ : cf. 41-93*a*3*g*	cf. 41-93*a*3*g*	
					$Nb^{93}(n, \alpha)\, Y^{90}$ - tot.			
41-93*i*1*t*	B58	61*h*	14.05 ± 0.55	9.0 ± 2.2		cf. 27-59*i*3		
41-93*i*2*t*	P61 IV	—	14.01 ± 0.10*¹ 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.31	9.3 ± 0.5 9.4 ± 0.5 9.5 ± 0.5 9.4 ± 0.5		cf. 22-46*a*2		
					$Nb^{93}(n, n\alpha)\, Y^{89m}$			
41-93*k*1*m*	B62 III	16.3 ± 1.3 sec*²	14.5 0.9	2.5 ± 1.1		cf. 41-93*a*3*g*		

*¹ Also measured for 7 MeV ≦ E_n ≦ 19.8 MeV
*² Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

MOLYBDENUM

$Mo^{92}(n, 2n) Mo^{91g} + Mo^{92}(n, 2n) Mo^{91m}$

I	II	III	IV	V	VI	VII	VIII	IX
42-92*a*1*g*+*m*	R61 II	15.2 ± 0.3 min* for Mo^{91g}	14.4 ± 0.3	211 ± 16		cf. 7-14*a*7		Element
42-92*a*2*g*+*m*	P53	75 sec for Mo^{91m} 15 min for Mo^{91g}	14.5 ± 0.35	190 ± 29		cf. 7-14*a*1		Element
42-92*a*3*g*+*m*	Y57	16.3 min for Mo^{91g}	14.1 ± 0.15	132 ± 21		cf. 13-27*b*4		
42-92*a*4*g*+*m*	B52	65 sec for Mo^{91m} 15 min for Mo^{91g}	14.25 ± 0.25	310 ± 87		cf. 29-63*a*4		Element 2.54 × 5.08 cm ; thickness 0.0127 cm
42-92*a*5*g*+*m*	R58 I	15.2 min for Mo^{91g}	14	188		cf. 8-19*a*2		
42-92*a*6*g*+*m*	S62	—	$14.6^{+0.2}_{-0.3}$	315 ± 35		cf. 37-87*a*1		

$Mo^{92}(n, 2n) Mo^{91g}$

I	II	III	IV	V	VI	VII	VIII	IX
42-92*a*1*g*	P62	16 min	14.7	198 ± 40	—	—	—	—

$Mo^{92}(n, p) Nb^{92g}$

I	II	III	IV	V	VI	VII	VIII	IX
42-92*b*1*g*	B62 III	9.9*d*	14.5 ± 0.9	58 ± 30		cf. 41-93*a*3*g*		

$Mo^{92}(n, \alpha) Zr^{89g}$

I	II	III	IV	V	VI	VII	VIII	IX
42-92*a*1*g*	B62 III	79*h*	14.5 ± 0.9	16 ± 7		cf. 41-93*a*3*g*		

$Mo^{94}(n, p) Nb^{94}$

I	II	III	IV	V	VI	VII	VIII	IX
42-94*b*1	B62 II	6.6 min	14.7	6.0 ± 1.5	—	—	—	—

* Measured by the authors

$Mo^{96}(n, p)\ Nb^{96}$

I	II	III	IV	V	VI	VII	VIII	IX
42-96*b*1	S62	—	$14.6^{+0.2}_{-0.3}$	21 ± 7		cf. 37-87*a*1		
42-96*b*2	B62 II	26*h*	14.7	36.6 ± 0.2	—	—	—	—

$Mo^{97}(n, p)\ Nb^{97}$

I	II	III	IV	V	VI	VII	VIII	IX
42-97*b*1	P53	76 min	14.5 ± 0.35	108 ± 10		cf. 7-14*a*1		Element
42-97*b*2	S62	—	$14.6^{+0.2}_{-0.3}$	68 ± 14		cf. 37-87*a*1		
42-97*b*3	B61 VI	—	14.8	110 ± 20	—	—	—	—

$Mo^{98}(n, p)\ Nb^{98}$

I	II	III	IV	V	VI	VII	VIII	IX
42-98*b*1	B62 II	51 min	14.7	9.0 ± 1.5	—	—	—	—

$Mo^{100}(n, 2n)\ Mo^{99}$

I	II	III	IV	V	VI	VII	VIII	IX
42-100*a*1	P53	68*h*	14.5 ± 0.35	3790 ± 1900		cf. 7-14*a*1		Element
42-100*a*2	S62	—	$14.6^{+0.2}_{-0.3}$	2039 ± 210		cf. 37-87*a*1		
24-10033	K61 II	67*h*	14.8 ± 0.5	1910 ± 190		cf. 17-35*a*5*m*		

$Mo^{100}(n, \alpha)\ Zr^{97}$

I	II	III	IV	V	VI	VII	VIII	IX
42-100*i*1	S62	—	$14.6^{+0.2}_{-0.3}$	14 ± 6		cf. 38-86*b*2		

$Mo^{nat}(n, p + n, pn)\ Nb$

I	II	III	IV	V	VI	VII	VIII	IX
42-*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^\circ} =$ 120 ± 20		cf. 11-23*d*1		

I	II	III	IV	V	VI	VII	VIII	IX
42-*d2* diff.	C59 I	—	14.5	$4\pi\left[\frac{d\sigma}{d\Omega}\right] = 31 \pm 3$ means for $\theta = 18^\circ$, 45°, 90°, 135° and $d\theta = 18^\circ$		cf. 29-*d2*		

$Mo^{nat}(n, np)$ Nb

I	II	III	IV	V	VI	VII	VIII	IX
42-*e1* diff.	C59 I	—	14.5	$4\pi\left[\frac{d\sigma}{d\Omega}\right] = 112 \pm 11$ means for $\theta = 18^\circ$, 45°, 135° and $d\theta = 18^\circ$		cf. 29-*d2*		

I	II	III	IV	V	VI	VII	VIII	IX

RUTHENIUM

$Ru^{96}(n, 2n) Ru^{95}$

I	II	III	IV	V	VI	VII	VIII	IX
44-96*a*1	P53	1.6*h*	14.5 ± 0.35	478 ± 90		cf. 7-14*a*1		RuO_2
44-96*a*2	K61 II	1.6*h*	14	616 ± 50		cf. 17-35*a*5*m*		
44-96*a*3	R61 II	1.63 ± 0.03*	14.4 ± 0.3	634 ± 55		cf. 7-14*a*7		Element

$Ru^{101}(n, p) Tc^{101}$

I	II	III	IV	V	VI	VII	VIII	IX
44-101*b*1	P53	15 min	14.5 ± 0.35	199 ± 140		cf. 7-14*a*1		RuO_2

* Measured by the authors

RHODIUM

I	II	III	IV	V	VI	VII	VIII	IX
$Rh^{103}(n, 2n)\ Rh^{102}$								
45-103*a*1	T60	—	13.9* 14.0 14.6 15.1	730 ± 80 740 ± 80 770 ± 80 790 ± 80	—	—	—	—
$Rh^{103}(n, He^3)\ Tc^{101}$								
45-103*f*1	B62 II	14 min	14.7	< 0.09		—	—	—
$Rh^{103}(n, p)\ Ru^{103} + Rh^{103}(n, pn + n, np + n, d)\ Ru^{102}$								
45-103*g*1 diff.	V57	—	14	$4\pi \left[\frac{d\sigma}{d\theta}\right] = 15 \pm 4$; means for $\theta = 30°$, 45°, 60°, 90°, 120°, 135°, 150° and $E_p >$ 7 MeV		cf. 12-*g*I		
45-103*g*2 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} = 4.8 \pm 0.5$ for $d\Omega = 0° — 15°$ and $E_p > 4$ MeV		cf. 51-*g*I		Foil, thickness 30-40 mg/cm^2
$Rh^{103}(n, \alpha)\ Tc^{100}$								
45-103*i*1	P53	80 sec	14.5 ± 0.35	63 ± 25		cf. 7-14*a*1		Rh_2O_3

* Also measured for 10.3 MeV $\leq E_n \leq$ 15.1 MeV

PALLADIUM

$Pd^{104}(n, p)\ Rh^{104g} + Pd^{104}(n, p)\ Rh^{104m}$

I	II	III	IV	V	VI	VII	VIII	IX
46-104*b*1*g*+*m*	P53	44 sec for Rh^{104g} 4.3 min for Rh^{104m}	14.5 ± 0.35	132 ± 66		cf. 7-14*a*1		Element

$Pd^{105}(n, p)\ Rh^{105}$

I	II	III	IV	V	VI	VII	VIII	IX
46-105*b*1	P53	36.5*h*	14.5 ± 0.35	743 ± 520		cf. 7-14*a*1		Element

$Pd^{108}(n, \alpha)\ Ru^{105}$

I	II	III	IV	V	VI	VII	VIII	IX
46-108*i*1	B58	4.5*h*	14.05 ± 0.55	2.3 ± 0.4		cf. 27-59*i*3		

$Pd^{110}(n, 2n)\ Pd^{109}$

I	II	III	IV	V	VI	VII	VIII	IX
46-110*a*1	P53	13*h*	14.5 ± 0.35	1948 ± 1000		cf. 7-14*a*1		Element

$Pd^{110}(n, \alpha)\ Ru^{107}$

I	II	III	IV	V	VI	VII	VIII	IX
46-110*i*1	P53	4 min	14.5 ± 0.35	13.8 ± 6.2		cf. 7-14*a*1		Element

$Pd^{nat}(n, p)\ Rh + Pd^{nat}(n, pn + n, np + n, d)\ Rh$

I	II	III	IV	V	VI	VII	VIII	IX
46-*g*1 diff.	V57	—	14	$4\pi\left[\frac{d\sigma}{d\theta}\right] = 7 \pm 2$ means for $\theta = 30^{\circ}$, 45°, 60°, 90°, 120°, 135°, 150° and $E_p >$ 8 MeV		cf. 12-*g*1		

I	II	III	IV	V	VI	VII	VIII	IX

SILVER

$Ag^{107}(n, 2n)\ Ag^{106}$ I 24.5 min.

47-107*a*1 I	P53	25 min	14.5 ± 0.35	519 ± 260		cf. 7-14*a*1		Element
47-107*a*2 I	F53	24.5 min	14.1	560 ± 56		cf. 13-27*b*2		
47-107*a*3 I	Y57	24.3 min	14.1 ± 0.15	458 ± 50		cf. 13-27*b*3		
47-107*a*4 I	V61	24 min	14.1	740 ± 80	rel. : cf. 13-27*i*10 $Al^{27}(n, \alpha)$ = 116 mb	β-activity, 4π geometry, prop. counter	Total error	Foil, 20 mg/cm^2 thickness
47-107*a*5 I	M61 II	24 min	14.8	662 ± 66		cf. 11-23*i*2		
47-107*a*6 I	R61 II	24.4 ± 0.5 min*[1]	14.4 ± 0.3	889 ± 65		cf. 7-14*a*7		Element
47-107*a*7 I	S61 II	24.5 min	14.1 ± 0.2	537 ± 15		cf. 13-27*b*12		
47-107*a*8 I	K61 II	24.2 min	14.8 ± 0.5	657 ± 100		cf. 17-35*a*5*m*		
47-107*a*9 I	T60	—	13.9*[2] 14.0 14.6 15.1	325 340 360 390	—	—	—	—

$Ag^{107}(n, 2n)\ Ag^{106}$ II 8*d*

47-107*a*1 II	V61	8.4*d*	14.1	600 ± 78	rel. : cf. 13-27*i*10 $Al^{27}(n, \alpha)$ = 116 mb	K-γ-coincidence with 2 NaI crystals	Total error	Foil, 0.3 mg/cm^2 thickness
47-107*a*2 II	M61 II	8.2*d*	14.8	~6500		cf. 11-23*i*2		
47-107*a*3 II	P61 IV		Rel. measurement*[3]			cf. 22-46*a*2		

*[1] Measured by the authors
*[2] Also measured for 10.3 MeV $\leq E_n \leq$ 15.1 MeV
*[3] Measured for 9.5 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Ag^{107}(n, n\alpha)\ Rh^{103m}$				
47-107*k*1*m*	B62 II	54 min	14.7	< 2.0	—	—	—	—
				$Ag^{109}(n, 2n)\ Ag^{108}$				
47-109*a*1	P53	2.3 min	14.5 ± 0.35	311 ± 150		cf. 7-14*a*1		Element
47-109*a*2	F52	2.3 min	14.1	1000 ± 100		cf. 13-27*b*2		
47-109*a*3	Y57	2.35 min	14.1 ± 0.15	604 ± 66		cf. 13-27*b*3		
47-109*a*4	V61	2.4 min	14.1	840 ± 150	rel. : cf. 47-107*a*4 I $Ag^{107}(n, 2n) = 740$ mb	β-activity, 2π geometry, prop. counter	Total error	Foil 20 mg/cm² thickness
47-109*a*5	K59 II	2.3 min	14.3 ± 0.5	619 ± 110		cf. 13-27*b*7		
47-109*a*6	M61 II	—	14.8	883 ± 88		cf. 24-50*a*2		
47-109*a*7	R59 I	2.3 min	14.8 ± 0.5	710 ± 110		cf. 17-35*a*3*m*		
				$Ag^{109}(n, p)\ Pd^{109}$				
47-109*b*1	C59 II	—	14.5	12.5 ± 1.9		cf. 49-115*i*2		
47-109*b*2	D58	14*h*	14	10.5 ± 1.8		cf. 48-112*i*2		
47-109*b*3	P61 IV	—	14.31 ± 0.13* 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31 14.93 ± 0.31	14.3 ± 1.7 14.9 ± 1.8 14.9 ± 1.8 14.8 ± 1.8 14.7 ± 1.8		cf. 22-46*a*2		
47-109*b*4	M61 II	—	14.8	2.7 ± 0.5		cf. 11-23*i*2		
				$Ag^{109}(n, \alpha)\ Rh^{106}$				
47-109*i*1	K59 II	140.8 min	14.3 ± 0.55	38 ± 6		cf. 13-27*b*7		

* Also measured for 7 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Ag^{109}(n, n\alpha)\ Rh^{105g}$				
47-109*k*1*g*	B62 II	36*h*	14.7	< 0.60	—	—	—	—
				$Ag^{nat}(n, 2n)\ Ag$				
47-*a*1	A58 II	—	14.1	1730 ± 130		cf. 1-2*a*1		Element
				$Ag^{nat}(n, p + n, pn)\ Pd$				
47-*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^0} < 14$		cf. 11-23*d*1		
47-*d*2 diff.	C59 I	—	14.5	$4\pi \left[\frac{d\sigma}{d0}\right] = 28 \pm 3$ means for $0 = 0^o$, 45^o, 90^o, 135^o and $d0 = 18^o$		cf. 29-*d*2		
				$Ag^{nat}(n, p + n, pn + n, np + n, d)\ Pd$				
47-*g*1 diff.	E59 I	—	14	$\frac{\sigma}{\text{Sterad.}} = 3.5 \pm 0.7$ for $d\Omega = 0^o - 15^o$ and $E_p > 4$ MeV		cf. 51-*g*1		Foil, 40-50 mg/cm² thickness

CADMIUM

I	II	III	IV	V	VI	VII	VIII	IX
					$Cd^{106}(n, 2n)\ Cd^{105}$			
48-106*a*1	R61 II	50.7 ± 1.0 min[*1]	14.4 ± 0.3	827 ± 63		cf. 7-14*a*7		Element
					$Cd^{106}(n, p)\ Ag^{106}$			
48-106*b*1	L58	24 min	14	76 ± 24	rel. : cf. 48-112*i*2 $Cd^{112}(n, \alpha)$ = 1.35 mb	β-activity, geiger counter, chem. separation	—	—
					$Cd^{111}(n, p)\ Ag^{111}$			
48-111*b*1	L58	—	14	15 ± 4		cf. 48-106*b*1		
48-111*b*2	P61 IV	—	14.01 ± 0.10[*2] 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.81 ± 0.31 14.93 ± 0.36	23.5 ± 1.4 22.5 ± 1.4 27.6 ± 1.7 28.8 ± 1.7 30.6 ± 1.8 36.5 ± 2.2		cf. 22-46*a*2		
					$Cd^{112}(n, p)\ Ag^{112}$			
48-112*b*1	L58	—	14	9.8 ± 3		cf. 48-106*b*1		
					$Cd^{112}(n, \alpha)\ Pd^{109}$			
48-112*i*1	P61 IV	—	13.88 ± 0.10[*3] 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31 14.93 ± 0.36	2.3 ± 0.1 2.8 ± 0.1 2.8 ± 0.1 3.1 ± 0.2 3.4 ± 0.2 3.3 ± 0.2 3.3 ± 0.2		cf. 22-46*a*2		

[*1] Measured by the authors
[*2] Also measured for 7 MeV $\leq E_n \leq$ 19.8 MeV
[*3] Also measured for 7 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
48-112*i*2	D58	14*h*	14.1	1.35 ± 0.27	rel. : cf. 27-63*a* $Cu^{63}(n, 2n)$ = 500 mb	β-activity,geiger-counter ; chemical separation. Corrections for absolute β-counting exp. determinated with standard sources and Al-foils of different thickness	Standard deviation	Thickness after chem. separation 2 mg/cm²

$Cd^{113}(n, p)\ Ag^{113}$

I	II	III	IV	V	VI	VII	VIII	IX
48-113*b*1	L58	—	14	7.2 ± 2.2		cf. 48-106*b*1		

$Cd^{114}(n, \alpha)\ Pd^{111g}$

I	II	III	IV	V	VI	VII	VIII	IX
48-114*ig*	D58	22 min	14.1	0.51 ± 0.13		cf. 48-112*i*2		

$Cd^{114}(n, \alpha)\ Pd^{111m}$

I	II	III	IV	V	VI	VII	VIII	IX
48-114*i*1*m*	D58	5.5*h*	14.1	0.13 ± 0.06		cf. 48-112*i*2		

$Cd^{116}(n, 2n)\ Cd^{115}$ - tot.

I	II	III	IV	V	VI	VII	VIII	IX
48-116*a*1*t*	P61 I	—	14.01 ± 0.10*	1690 ± 118		cf. 22-46*a*2		
			14.09 ± 0.10	1604 ± 115				
			14.31 ± 0.13	1748 ± 124				
			14.50 ± 0.20	1634 ± 116				
			14.68 ± 0.26	1642 ± 117				
			14.81 ± 0.31	1588 ± 113				
			14.93 ± 0.36	1634 ± 116				

$Cd^{116}(n, 2n)\ Cd^{115g}$

I	II	III	IV	V	VI	VII	VIII	IX
48-116*a*1*g*	K61 II	53.5*h*	14.8 ± 0.5	690 ± 100		cf. 17-35*a*5*m*		

* Also measured for 8.8 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
48-116*a*2*g*	P61 I	53*h*	14.01 ± 0.10*	850 ± 85		cf. 22-46*a*2		
			14.09 ± 0.10	835 ± 84				
			14.31 ± 0.13	863 ± 86				
			14.50 ± 0.20	826 ± 83				
			14.68 ± 0.26	817 ± 82				
			14.81 ± 0.31	781 ± 78				
			14.93 ± 0.36	798 ± 80				

$Cd^{116}(n, 2n)\,Cd^{115m}$

I	II	III	IV	V	VI	VII	VIII	IX
48-116*a*1*m*	P61 I	43*d*	14.01 ± 0.10*	840 ± 84		cf. 22-46*a*2		
			14.09 ± 0.10	769 ± 77				
			14.31 ± 0.13	855 ± 86				
			14.50 ± 0.20	808 ± 81				
			14.68 ± 0.26	825 ± 83				
			14.81 ± 0.31	807 ± 81				
			14.93 ± 0.36	836 ± 84				
48-116*a*2*m*	K61 II	43.5*d*	14.8 ± 0.5	490 ± 70		cf. 17-35*a*5*m*		

$Cd^{nat}(n, 2n)\,Cd$

I	II	III	IV	V	VI	VII	VIII	IX
48-*a*1	A58 II	—	14.1	1920 ± 150		cf. 1-2*a*1		

$Cd^{nat}(n, p)\,Ag + Cd^{nat}(n, pn)\,Ag$

I	II	III	IV	V	VI	VII	VIII	IX
48-*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\Omega}\right]_{120^0} < 14$		cf. 11-23*d*1		

$Cd^{nat}(n, p + n, pn + n, np + n, d)\,Ag$

I	II	III	IV	V	VI	VII	VIII	IX
48-*g*1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} = 3.8 \pm 0.4$ for $d\Omega$ — 0° — 15° and $E_p > 5$ MeV		cf. 51-*g*1		Foil, 30-40 mg/cm² thickness

* Also measured for 12 MeV $\leq E_n \leq$ 19.8 MeV

INDIUM

$In^{115}(n, 2n) In^{114m}$ I 42 msec.

I	II	III	IV	V	VI	VII	VIII	IX
49-115*a*1*m* I	G59 I	42 ± 2 msec*1	14.5	800 ± 400	rel. : cf. 29-63*a* $Cu^{63}(n, 2n)$ = 500 mb	cf. 12-24*b*1*m*		

$In^{115}(n, 2n) In^{114m}$ II 50*d*

I	II	III	IV	V	VI	VII	VIII	IX
49-115*a*2*m* II	P61 I	50.0*d*	13.88 ± 0.10*2 14.01 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.81 ± 0.31 14.93 ± 0.36	1523 ± 76 1557 ± 78 1500 ± 77 1539 ± 77 1585 ± 79 1503 ± 76		cf. 22-46*a*2		

$In^{115}(n, p) Cd^{115}$

I	II	III	IV	V	VI	VII	VIII	IX
49-115*b*1	D58	—	14.5	15.5 ± 4		cf. 48-112*i*2		
49-115*b*2	P61 VI	—	14	20 ± 9	—	—	—	—

$In^{115}(n, \alpha) Ag^{112}$

I	II	III	IV	V	VI	VII	VIII	IX
49-115*i*1	B55 III	3.2*h*	14.05 ± 0.55	2.5 ± 0.4		cf. 27-59*i*3		
49-115*i*2	C59 II	—	14.5	2.89 ± 0.29	rel. : $Al^{27}(n, \alpha)$ = ?	β-activity. 4π geometry prop. counter. Activity measured after chem. separation with a foil of 20 μg/cm². Absorption and scattering of the β in the foil neglected	Standard deviation contains : statistics ; neutron flux ; chem. separation	—

*1 Measured by the authors
*2 Also measured for 9.3 MeV ≦ E_n ≦ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$In^{115}(n, n\alpha)\ Ag^{111g}$				
49-115*k*1	B62 II	7.5*d*	14.7	< 0.055	—	—	—	—
				$In^{nat}(n, p + n, pn)\ Cd$				
49-*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d\theta}\right]_{120^0} < 14$		cf. 11-23*d*1		
				$In^{nat}(n, p + n, pn + n, np + n, d)\ Cd$				
49-*g*1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} = 1.6 \pm 0.3$ for $d\Omega = 0^o - 15^o$ and $E_p > 4.5$ MeV		cf. 51-*g*1		Foil. 30-40 mg/cm² thickness
49-92 diff.	V57	—	14	$4\pi \left[\frac{d\sigma}{d\theta}\right] = 20 \pm 9$ means for $\theta = 30^o, 45^o, 60^o, 90^o, 120^o, 135^o, 150^o$ and $E_p >$ 8 MeV		cf. 12-*g*1		

I	II	III	IV	V	VI	VII	VIII	IX
					TIN			
					$Sn^{112}(n, 2n)\ Sn^{111}$			
50-112*a*1	R59 I	32.5 min	14	1400 ± 110		cf. 17-35*a*3*m*		
50-112*a*2	R61 II	32.1 ± 0.6 min*1	14.4 ± 0.3	1508 ± 122		cf. 7-14*a*7		Element
50-112*a*3	P61 I		Rel. measurement*2			cf. 22-46*a*2		
50-112*a*4	T60	—	13.9*3	725 ± 80	—	—	—	—
					$Sn^{116}(n, p)\ In^{116} + Sn^{116}(n, pn + n, np + n, d)\ In^{115}$			
50-*g*1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} < 1$ for $d\Omega = 0° — 15°$ and $E_p > 4$ MeV		cf. 51-*g*1		Sn^{116} enriched 98 %: thickness 10 mg/cm²
					$Sn^{118}(n, \alpha)\ Cd^{115}$			
50-118*i*1	P61 IV	53*h*	13.88 ± 0.10*4	0.76 ± 0.05		cf. 22-46*a*2		
			14.09 ± 0.10	0.93 ± 0.07				
			14.31 ± 0.13	0.94 ± 0.07				
			14.50 ± 0.20	1.14 ± 0.08				
			14.68 ± 0.26	1.13 ± 0.08				
			14.81 ± 0.31	1.23 ± 0.09				
					$Sn^{120}(n, p)\ In^{120g}$			
50-120*b*1*g*	P60 II	3 sec	14.8 ± 0.8	~1		cf. 27-59*a*1*g*		Sn^{120} enriched
					$Sn^{120}(n, p)\ In^{120m}$			
50-120*b*1*m*	P60 II	50 sec	14.8 ± 0.8	2.8 ± 1		cf. 27-591*g*		Sn^{120} enriched

*1 Measured for the authors
*2 Measured for 11.2 MeV $\leq E_n \leq$ 19.8 MeV
*3 Also measured for 11.8 MeV and 12.9 MeV
*4 Also measured for 12 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
$Sn^{120}(n, p)\,In^{120} + Sn^{120}(n, pn + n, np + n, d)\,In^{119}$								
50-120*g*1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} < 1$ for $d\Omega = 0^{o} - 15^{o}$ and $E_p > 4$ MeV		cf. 50-*g*1		Sn^{120} enriched 98 %: thickness 10 mg/cm^2
$Sn^{nat}(n, p + n, pn)\,In$								
50-*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\theta}\right]_{120^{o}} < 15$		cf. 11-23*d*1		

I	II	III	IV	V	VI	VII	VIII	IX

ANTIMONY

$Sb^{121}(n, 2n)\, Sb^{120}$ I 16 min.

I	II	III	IV	V	VI	VII	VIII	IX
51-121*a*1 I	P53	15 min	14.5 ± 0.35	750 ± 150		cf. 7-14*a*1		Element
51-121*a*2 I	R58 I	15.7 min	14	1000		cf. 7-14*a*2		
51-121*a*3 I	K59 III	16.2 min	14.3 ± 0.5	453 ± 41		cf. 13-27*b*7		
51-121*a*4 I	R61 II	15.7 ± 0.3 min*1	14.4 ± 0.3	1056 ± 80		cf. 7-14*a*7		Element
51-121*a*5 I	K61 II	16.5 min	14.8 ± 0.5	1180 ± 180		cf. 17-35*a*5*m*		

$Sb^{121}(n, 2n)\, Sb^{120}$ II 5.8*d*

I	II	III	IV	V	VI	VII	VIII	IX
51-121*a*1 II	P61 I		Rel. measurement*2			cf. 22-46*a*2		

$Sb^{123}(n, 2n)\, Sb^{122g+m}$

I	II	III	IV	V	VI	VII	VIII	IX
51-123*a*1*g*+*m*	P53	2.8*d*	14.5 ± 0.35	1245 ± 300		cf. 7-14*a*1		Element
51-123*a*2*g*+*m*	K59 II	2.8*d*	14.3 ± 0.5	1706 ± 100		cf. 13-27*b*7		
51-123*a*3*g*+*m*	K61 II	2.8*d*	14.8 ± 0.5	1950 ± 200		cf. 17-35*a*5*m*		
51-123*a*4*g*+*m*	P61 IV	—	14.00 ± 0.10*3	1280 ± 70		cf. 22-46*a*2		
			14.09 ± 0.10	1336 ± 65				
			14.31 ± 0.13	1263 ± 60				
			14.50 ± 0.20	1342 ± 70				
			14.68 ± 0.26	1255 ± 65				
			14.81 ± 0.31	1280 ± 65				
			14.93 ± 0.36	1192 ± 60				

*1 Measured by the authors
*2 Measured for 9.4 MeV $\leqq E_n \leqq$ 19.8 MeV
*3 Also measured for 12 MeV $\leqq E_n \leqq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX

$Sb^{nat}(n, p + n, pn)$ Sn

I	II	III	IV	V	VI	VII	VIII	IX
51-*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d0}\right]_{120^0} = 11 \pm 6$		cf. 11-23*d*1		

$Sb^{nat}(n, p + n, pn + n, np + n, d)$ Sn

I	II	III	IV	V	VI	VII	VIII	IX
51-*g*1 diff.	P59 III	—	14	$\frac{d\sigma}{d\Omega} = 22 \pm 4$ for $d\Omega = 0^0 - 60^0$ and $E_p > 5$ MeV	abs. : proton recoil-telescope	Telescope ; 2 prop. counters in coincidence with a CsI crystal	Stat. error	Thickness 7 mg/cm²
51-*g*2 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} = 40 \pm 2$ for $d\Omega = 0^0 - 15^0$ and $E_p > 5$ MeV		cf. 50-*g*1		Thickness 30-40 mg/cm²

TELLURIUM

I	II	III	IV	V	VI	VII	VIII	IX
$Te^{128}(n, 2n)\ Te^{127}$								
52-128*a*1	P53	9.3*h*	14.5 ± 0.35	< 779 ± 230		cf. 7-14*a*1		Element
$Te^{128}(n, pn)\ Sb^{127} + Te^{128}(n, np + n, d)\ Sb^{127}$								
52-128*c*1	B59 II	—	14.5	0.33 ± 0.05	rel. : cf. 13-27*i*5 $Al^{27}(n, \alpha) = 111$ mb Sandwich method	Activation method, 4π counter ; chemical separation. $\sigma(n, np)$ and $\sigma(n, d)$ are supposed to be small	—	Foils ; 50 mg/cm² thickness. Isotopically enriched targets
$Te^{130}(n, 2n)\ Te^{129g+m}$								
52-130*a*1*g*+*m*	P53	70 min, 32*d*	14.5 ± 0.35	599 ± 120		cf. 7-14*a*1		
$Te^{130}(n, pn)\ Sb^{129} + Te^{130}(n, np + n, d)\ Sb^{129}$								
52-130*c*1	B59 II	—	14.5	0.17 ± 0.02		cf. 52-128*c*1		
$Te^{130}(n, \alpha)\ Sn^{127}$								
52-130 *i*1	C59 II	—	14.5	0.37 ± 0.06		cf. 49-115*i*2		
$Te^{nat}(n, p + n, pn)\ Sb$								
52-*d*1 diff.	A61	—	14.1	$4\pi\left[\frac{d\sigma}{d\Omega}\right]_{120^0} < 5$		cf. 11-23*d*1		
$Te^{nat}(n, p + n, pn + n, np + n, d)\ Sb$								
52-*g*1 diff.	E59 II	—	14	$\frac{\sigma}{\text{Sterad.}} < 1$ for $d\Omega = 0^o - 15^o$ and $E_p > 5$ MeV		cf. 51-*g*1		Powder 40 mg/cm² thickness

I	II	III	IV	V	VI	VII	VIII	IX

IODINE

$I^{127}(n, 2n)\ I^{126}$

I	II	III	IV	V	VI	VII	VIII	IX
53-127*a*1	P53	13*d*	14.5 ± 0.35	1120 ± 400		cf. 7-14*a*1		NH_4I ; ; LiI
53-127*a*2	M53	13.1*d*	14.1*1	1300 ± 80	abs. : Long-counter calibrated with a Ra-Be source	β-activity ; NaI crystal served as target and counter	Estimated total error	NaI crystal
53-127*a*3	B62 I	13.05 ± 0.08*d**2	14.1 ± 0.1*3	13.20 ± 110		cf. 29-65*a*8		I_2O_5

$I^{127}(n, p)\ Te^{127}$

I	II	III	IV	V	VI	VII	VIII	IX
53-127*b*1	P53	9.3*h*	14.5 ± 0.35	< 231 ± 140		cf. 7-14*a*1		NH_4I : LiI
53-127*b*2	B60	9*h*	14.1 ± 0.1	25 ± 15		cf. 11-23*b*2		
53-127*b*3	D58	—	14.5	11.7 ± 1.8		cf. 48-112*i*2		

$I^{127}(n, p)\ Te^{127} + I^{127}(n, pn)\ Te^{126}$

I	II	III	IV	V	VI	VII	VIII	IX
53-127*d*1 diff.	A61	—	14.1	$4\pi \left[\frac{d\sigma}{d0}\right]_{120^0} = 5$		cf. 11-23*d*1		
53-127*d*2	B61 IV	—	14.1 ± 0.1*4	13.1 ± 1.3 by évaporation 2.1 ± 0.2 by direct-processes	rel. : cf. 3-6*h*5 $Li^6(n, \alpha) = 25.8$ mb and the assumption $\sigma_i^{127}(n, p) \approx \sigma_{cs}^{133}(n, p)$	CsI crystal served as target and counter. Separation of α-, *p*- and γ-pulses by pulse shape discrimination. Separation of *n*, *p*- and *n*,*np*-processes and of evaporation- and direct-processes by stat. theory	Error contains : neutron flux ; pulse shape discrimination ; statistics.	CsI crystal

*1 Also measured for 9.5 MeV $\leq E_n \leq$ 18 MeV
*2 Measured by the authors
*3 Also measured for 12.8 MeV $\leq E_n \leq$ 19.6MeV
*4 Also measured for 13 MeV $\leq E_n \leq$ 21 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$I^{127}(n, np)\ Te^{126}$				
53-127*e*1	B61 IV	—	14.1 ± 0.1*1	1.3 ± 0.2	rel. : cf. 3-6*h*5 $Li^6(n, \alpha) = 25.8$ mb and the assumption $\sigma_I{}^{127}(n, np) \approx \sigma_{Cs}{}^{133}(n, np)$	cf. 53-127*d*2		
				$I^{127}(n, \alpha)\ Sb^{124}$				
53-127*i*1	P53	20 min	14.5 ± 0.35	< 18.4 ± 2.8		cf. 7-14*a*1		NH_4I ; LiI
53-127*i*2	B61 IV	—	14.1 ± 0.1*	1.08 ± 0.13	cf. 53-127*d*2 and for *p*- say α			
				$I^{127}(n, n\alpha)\ Sb^{123}$				
53-127*k*1	B61 IV	—	14.1 ± 0.1*	0.02 ± 0.004	cf. 53-127*e*1 and for *p* say α			

*1 Also measured for 13 MeV $\leq E_n \leq$ 21 MeV

I	II	III	IV	V	VI	VII	VIII	IX

CESIUM

I	II	III	IV	V	VI	VII	VIII	IX
				$Cs^{133}(n, 2n)\ Cs^{132}$				
55-133*a*1	M61 I	—	14.1	1550 ± 250		cf. 38-86*a*1*m*		Cs_2CO_3 powder
55-133*a*2	B62 I	6.44 ± 0.05*[1]	14.1 ± 0.1*[2]	1289 ± 130		cf. 29-65*a*8		Cs_2CO_3
				$Cs^{133}(n, p)\ Xe^{133} + Cs^{133}(n, pn)\ Xe^{132}$				
55-133*d*1	B61 IV	—	14.1 ± 0.1*[3]	13.1 ± 1.3 by evaporation 2.1 ± 0.2 by direct processes		cf. 53-127*d*2		
				$Cs^{133}(n, np)\ Xe^{132}$				
55-133*e*1	B61 IV	—	14.1 ± 0.1*[3]	1.3 ± 0.2		cf. 52-127*e*1		
				$Cs^{133}(n, He^3)\ I^{131}$				
55-133*f*1	B62 II	8.1*d*	14.7	< 0.15	—	—	—	—
				$Cs^{133}(n, 2p)\ I^{132}$				
55-133*h*1	B62 II	2.3*h*	14.7	< 0.005	—	—	—	—
				$Cs^{133}(n, \alpha)\ I^{130}$				
55-133*i*1	B58	12.6*h*	14.05 ± 0.05	1 ± 0.3		cf. 27-59*i*3		
55-133*i*2	C59 II	—	14.5	1.9 ± 0.2		cf. 49-115*i*2		
55-133*i*3	B61 IV	—	14.1 ± 0.1*[3]	1.08 ± 0.13		cf. 53-127*i*2		

*[1] Measured by the authors
*[2] Also measured for 13 MeV $\leq E_n \leq$ 19.6 MeV
*[3] Also measured for 13 MeV $\leq E_n \leq$ 21 MeV

I	II	III	IV	V	VI	VII	VIII	IX
				$Cs^{133}(n, n\alpha)\ I^{129}$				
55-133*k*1	B61 IV	—	14.1 ± 0.1*	0.02 ± 0.004		cf. 53-127*k*1		

* Also measured for 13 MeV $\leq E_n \leq$ 21 MeV

I	II	III	IV	V	VI	VII	VIII	IX
					BARIUM			
					$Ba^{134}(n, 2n)\ Ba^{133m}$			
56-134*a*1*m*	W60 I	38.9 ± 0.1*h**	14.8 ± 0.8	940 ± 80		cf. 13-27*b*4		BaO_2; $BaCl_2.2HO$ $Ba(NO_3)_2$; thickness 30-150 mg/cm²
					$Ba^{136}(n, 2n)\ Ba^{135m}$			
56-136*a*1*m*	W60 I	28.7 ± 0.2*h**	14.8 ± 0.8	700 ± 80		cf. 13-27*b*4		cf. 56-134*a*1*m*
					$Ba^{136}(n, p)\ Cs^{136}$			
56-136*b*1	W60 I	13.5 ± 0.5*d**	14.8 ± 0.8	49 ± 10		cf. 13-27*b*4		cf. 56-134*a*1*m*
56-136*b*2	C59 II	—	14.5	38.3 ± 4		cf. 49-115*i*2		
					$Ba^{138}(n, 2n)\ Ba^{137m}$			
56-138*a*1*m*	W60 I	2.6 ± 0.1 min*	14.8 ± 0.8	1250 ± 100		cf. 13-27*b*4		cf. 56-134*a*1*m*
					$Ba^{138}(n, p)\ Cs^{138}$			
56-138*b*1	P53	33 min	14.5 ± 0.35	6.3 ± 2.2		cf. 7-14*a*1		$BaCO_3$
56-138*b*2	W60 I	32.5 ± 0.5 min*	14.8 ± 0.8	2.5 ± 1.2		cf. 13-27*b*4		
56-138*b*3	C59 II	—	14.5	2.2 ± 0.3		cf. 49-115*i*2		
					$Ba^{138}(n, \alpha)\ Xe^{135g}$			
56-138*i*1*g*	F61 II	—	14.2 ± 0.2	13 ± 2		cf. 13-27*b*11		
					$Ba^{138}(n, \alpha)\ Xe^{135m}$			
56-138*i*1*m*	F61 II	—	14.1 ± 0.2	13 ± 2		cf. 13-27*b*11		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

LANTHANUM

$La^{139}(n, p)\, Ba^{139}$

I	II	III	IV	V	VI	VII	VIII	IX
57-139*b*1	P53	85 min	14.5 ± 0.35	5.7 ± 2.4		cf. 7-14*a*1		$La(NO_3)_3$
57-139*b*2	W60 I	85 ± 1 min*	14.8 ± 0.8	5 ± 1		cf. 13-27*b*4		La_2O_3 ; $La(NO_3)_3 \cdot CH_2O$; thickness 35-180 mg/cm²
57-139*b*3	C59 II	—	14.5	2.33 ± 0.35		cf. 49-115*i*2		

$La^{139}(n, 2p)\, Cs^{138}$

I	II	III	IV	V	VI	VII	VIII	IX
57-139*h*1	B62 II	32 min	14.7	< 0.032	—	—	—	—

$La^{139}(n, \alpha)\, Cs^{136}$

I	II	III	IV	V	VI	VII	VIII	IX
57-139*i*1	W60 I	13.5 ± 1.5*d**	14.8 ± 0.8	1.3		cf. 13-27*b*4		cf. 57-139*b*2
57-139*i*2	C59 II	—	14.5	187 ± 20		cf. 49-115*i*2		

* Measured by the authors

CERIUM

$Ce^{140}(n, 2n)\,Ce^{139\ tot}$.

I	II	III	IV	V	VI	VII	VIII	IX
58-140*a*1*t*	W60 I	—	14.8 ± 0.8	3000 ± 400		cf. 27-59*a*1*g*		cf. 58-140*a*1*m*

$Ce^{140}(n, 2n)\,Ce^{139g}$

I	II	III	IV	V	VI	VII	VIII	IX
58-140*a*1*g*	W60 I	140 ± 10*d**	14.8 ± 0.8	1800 ± 400		cf. 27-59*a*1*g*		cf. 58-140*a*1*m*

$Ce^{140}(n, 2n)\,Ce^{139m}$

I	II	III	IV	V	VI	VII	VIII	IX
58-140*a*1*m*	W60 I	65 ± 10 sec*	14.8 ± 0.8	1200 ± 400		cf. 27-59*a*1*g*		$Ce(NO_3)_3 . 6H_2O$; thickness 30-120 mg/cm^2
58-140*a*2*m*	P61 III	57 ± 5 sec*	14.1 ± 0.1	1440 ± 160		cf. 13-27*b*8		

$Ce^{140}(n, p)\,La^{140}$

I	II	III	IV	V	VI	VII	VIII	IX
58-140*b*1	W60 I	40 ± 2*h**	14.8 ± 0.8	10 ± 2		cf. 27-59*a*1*g*		cf. 58-140*a*1*m*
58-140*b*2	C59 II	—	14.5	12.1 ± 1.2		cf. 49-115*i*2		

$Ce^{140}(n, \alpha)\,Ba^{137m}$

I	II	III	IV	V	VI	VII	VIII	IX
58-140*i*1*m*	P53	2.5 min	14.5 ± 0.35	12.1 ± 6		cf. 7-14*a*1		$Ce(NO_3)_3$
58-140*i*2*m*	W60 I	2.6 ± 0.1 min*	14.8 ± 0.8	9 ± 2		cf. 27-59*a*1*g*		cf. 58-104*a*1*m*

$Ce^{142}(n, 2n)\,Ce^{141}$

I	II	III	IV	V	VI	VII	VIII	IX
58-142*a*1	W60 I	32 ± 2*d**	14.8 ± 0.8	1600 ± 300		cf. 27-59*a*1*g*		cf. 58-140*a*1*m*

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
					$Ce^{142}(n, p)\ La^{141}$			
58-142*b*1	W60 I	77 ± 3 min*	14.8 ± 0.8	5 ± 2		cf. 27-59*a*1*g*		cf. 58-140*a*1*m*
58-142*b*2	C59 II	—	14.5	9.4 ± 0.9		cf. 49-115*i*2		
					$Ce^{142}(n, pn)\ La^{141} + Ce^{142}(n, np + n, d)\ La^{141}$			
58-142*c*1	B59 II	—	14.5	1.0 ± 0.2		cf. 52-128*e*1		
					$Ce^{142}(n, \alpha)\ Ba^{139}$			
58-142*i*1	W60 I	85 ± 1 min*	14.8 ± 0.8	8 ± 2		cf. 27-59*a*1*g*		cf. 58-140*a*1*m*
58-142*i*2	C59 II	—	14.5	7.04 ± 0.7		cf. 49-115*i*2		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

PRASEODYNIUM

$Pr^{141}(n, 2n) Pr^{140}$

I	II	III	IV	V	VI	VII	VIII	IX
59-141*a*1	P53	3.4 min	14.5 ± 0.35	2060 ± 700		cf. 7-14*a*1		PrO_2
59-141*a*2	W60 I	3.5 ± 0.2 min*[1]	14.8 ± 0.8	2100 ± 300		cf. 13-27*b*4		Element, PrO_2 $Pr(NO_3)_3.6H_2O$ thickness 20-130 mg/cm²
59-141*a*3	R58 I	3.27 min	14	1768		cf. 7-14*a*2		
59-141*a*4	F60	—	13.77 ± 0.20*[2] 14.74 ± 0.27	1386 ± 125 1591 ± 143		cf. 7-14*a*3		PrO_2
59-141*a*5	R61 II	3.13 ± 0.09 min*[1]	14.4 ± 0.3	1801 ± 135		cf. 7-14*a*7		Pr_6O_{11}
59-141*a*6	K61 II	3.5 min	14.8 ± 0.5	1378 ± 206		cf. 17-35*a*5*m*		

$Pr^{141}(n, p) Ce^{141}$

I	II	III	IV	V	VI	VII	VIII	IX
59-141*b*1	W60 I	32 ± 2*d**[1]	14.8 ± 0.8	4.5 ± 1.0		cf. 13-27*b*4		cf. 59-141*a*2

$Pr^{141}(n, 2p) La^{140}$

I	II	III	IV	V	VI	VII	VIII	IX
59-141*h*1	B62 II	40.2*h*	14.7	< 0.84	—	—	—	—

*[1] Measured by the authors
*[2] Also measured for 12.5 MeV ≦ E_n ≦ 18 MeV

I	II	III	IV	V	VI	VII	VIII	IX

NEODYMIUM

I	II	III	IV	V	VI	VII	VIII	IX
				$Nd^{142}(n, 2n)\ Nd^{141}$				
60-142*a*1	W60 I	2.5 ± 0.3*h**	14.8 ± 0.8	2060 ± 200		cf. 27-59*a*1*g*		Nd_2O_3 nat. and isotop. enriched Nd^{148} (84.59 %); Nd^{150} (93.5 %)
60-142*a*2	R59 I	2.53*h*	14	2480 ± 200		cf. 17-35*a*3*m*		
60-142*a*3	R61 II	2.54 ± 0.05*h**	14.4 ± 0.3	2411 ± 200		cf. 7-14*a*7		Nd_2O_3
				$Nd^{142}(n, p)\ Pr^{142}$				
60-142*b*1	C59 II	—	14.5	13.5 ± 2.7		cf. 19-115*i*2		
				$Nd^{142}(n, \alpha)\ Ce^{139g}$				
60-142*i*1*g*	W60 I	140 ± 10*d**	14.8 ± 0.8	2 ± 1		cf. 27-59*a*1*g*		cf. 60-142*a*1
				$Nd^{142}(n, \alpha)\ Ce^{139m}$				
60-142*i*1*m*	W60I	65 ± 10 sec*	14.8 ± 0.8	10 ± 2		cf. 27-59*a*1*g*		cf. 60-142*a*1
				$Nd^{143}(n, p)\ Pr^{143}$				
60-143*b*1	C59 II	—	14.5	11.5 ± 2.3		cf. 49 -115*i*2		
				$Nd^{146}(n, \alpha)\ Ce^{143}$				
60-146*i*1	W60 I	34 ± 2*h**	14.8 ± 0.8	8.3 ± 2		cf. 27-59*a*1*g*		cf. 60-142*a*1
60-146*i*2	C59 II	—	14.5	2.6 ± 0.4		cf. 49-115*i*2		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX
				$Nd^{148}(n, 2n)\ Nd^{147}$				
60-148*a*1	W60 I	11.5 ± 0.5*d**	14.8 ± 0.8	2160 ± 200		cf. 27-59*a*1*g*		cf. 60-142*a*1
				$Nd^{148}(n, p)\ Pr^{148}$				
60-148*b*1	W60 I	12 ± 3 min*	14.8 ± 0.8	3.5 ± 0.8		cf. 27-59*a*1*g*		cf. 60-142*a*1
				$Nd^{148}(n, \alpha)\ Ce^{145}$				
60-148*i*1	W60 I	3.1 ± 0.2 min*	14.8 ± 0.8	5 ± 1		cf. 27-59*a*1*g*		cf. 60-142*a*1
				$Nd^{150}(n, 2n)\ Nd^{149}$				
60-150*a*1	W60 I	1.8 ± 0.1*h**	14.8 ± 0.8	2200 ± 300		cf. 27-59*a*1*g*		cf. 60-142*a*1

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

SAMARIUM

$Sm^{144}(n, 2n)\, Sm^{143}$

I	II	III	IV	V	VI	VII	VIII	IX
62-144*a*1	W58	8.5 ± 0.3 min*	14.8 ± 0.9	1200 ± 300		cf. 13-27*b*4		Sm_2O_3 nat. and enriched; Sm^{154}: 97.2 %; Sm^{152}: 99.7 %; thickness 35-120 mg/cm²
62-144*a*2	R61 II	9.4 ± 0.6 min*	14.4 ± 0.3	1484 ± 120		cf. 7-14*a*7		Sm_2O_3

$Sm^{152}(n, p)\, Pm^{152}$

I	II	III	IV	V	VI	VII	VIII	IX
62-152*b*1	W58	6.5 ± 0.5 min*	14.8 ± 0.9	3.7 ± 0.2		cf. 13-27*b*4		cf. 62-144*a*1

$Sm^{152}(n, \alpha)\, Nd^{149}$

I	II	III	IV	V	VI	VII	VIII	IX
62-152*i*1	P53	1.7*h*	14.5 ± 0.35	8.9 ± 5		cf. 7-14*a*1		Sm_2O_3
62-152*i*2	W58	1.6 ± 0.3*h**	14.8 ± 0.9	10 ± 2		cf. 13-27*b*4		cf. 62-144*a*1

$Sm^{154}(n, 2n)\, Sm^{153}$

I	II	III	IV	V	VI	VII	VIII	IX
62-154*a*1	P53	47*h*	14.5 ± 0.35	< 2250 ± 900		cf. 7-14*a*1		Sm_2O_3
62-154*a*2	W58	45 ± 3*h**	14.8 ± 0.9	1500 ± 300		cf. 13-27*b*4		cf. 62-144*a*1

$Sm^{154}(n, p)\, Pm^{154}$

I	II	III	IV	V	VI	VII	VIII	IX
62-154*b*1	W58	2.5 ± 0.5 min*	14.8 ± 0.9	3.5 ± 0.2		cf. 13-27*b*4		cf. 62-144*a*1

$Sm^{154}(n, \alpha)\, Nd^{151}$

I	II	III	IV	V	VI	VII	VIII	IX
62-154*i*1	W58	17.3 ± 0.5 min*	14.8 ± 0.9	9 ± 3		cf. 13-27*b*4		cf. 62-144*a*1

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

EUROPIUM

$Eu^{151}(n, 2n)\ Eu^{150g}$

I	II	III	IV	V	VI	VII	VIII	IX
163-15*a*1*g*	W60 I	15 ± 1*h**	14.8 ± 0.8	500 ± 200		cf. 13-27*b*4		Eu_2O_3 thickness 23 mg/cm²
63-151*a*2*g*	K61 II	13.4*h*	14.8 ± 0.5	640 ± 64		cf. 17-35*a*5*m*		

$Eu^{153}(n, 2n)\ Eu^{152m}$

I	II	III	IV	V	VI	VII	VIII	IX
63-153*a*1*m*	W60 I	9.3 ± 0.5*h**	14.8 ± 0.8	750 ± 200		cf. 13-27*b*4		cf. 63-151*a*1*g*
63-153*a*2*m*	K61 II	9.3*h*	14.8 ± 0.5	164 ± 25		cf. 17-35*a*5*m*		

$Eu^{153}(n, p)\ Sm^{153}$

I	II	III	IV	V	VI	VII	VIII	IX
63-153*b*1	C59 II	—	14.5	7.4 ± 0.7		cf. 49-115*i*2		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

GADOLINIUM

$Gd^{156}(n, \alpha) Sm^{153}$

I	II	III	IV	V	VI	VII	VIII	IX
64-156*i*1	C59 II	—	14.5	3.22 ± 0.48		cf. 49-115*i*2		

$Gd^{157}(n, p) Eu^{157}$

I	II	III	IV	V	VI	VII	VIII	IX
64-157*b*1	C59 II	—	14.5	11.3 ± 1.7		cf. 49-115*i*2		

$Gd^{160}(n, 2n) Gd^{159}$

I	II	III	IV	V	VI	VII	VIII	IX
64-160*a*1	P53	18*h*	14.5 ± 0.35	1470 ± 820		cf. 7-14*a*1		Gd_2O_3
64-160*a*2	W60 I	18 ± 0.3*h**	14.8 ± 0.8	1450 ± 300		cf. 13-27*b*4		Gd_2O_3 enriched : Gd^{160} : 95.3 % ; thickness 50-200 mg/cm²
64-160*a*3	K61 II	17.4*h*	14.8 ± 0.5	1725 ± 170		cf. 17-35*a*5*m*		

$Gd^{160}(n, \alpha) Sm^{157}$

I	II	III	IV	V	VI	VII	VIII	IX
64-160*i*1	W60 I	0.5 ± 0.1 min*	14.8 ± 0.8	2 ± 1		cf. 13-27*b*4		cf. 64-160*a*2

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

TERBIUM

$Tb^{159}(n, p)\ Gd^{159}$

I	II	III	IV	V	VI	VII	VIII	IX
65-159*b*1	B61 VI	—	14.8	~2.2	—	—	—	—

$Tb^{159}(n, 2p)\ Eu^{158}$

I	II	III	IV	V	VI	VII	VIII	IX
65-159*h*1	B62 II	60 min	14.7	< 0.080	—	—	—	—

I	II	III	IV	V	VI	VII	VIII	IX
					DYSPROSIUM			
					$Dy^{162}(n, \alpha)\ Gd^{159}$			
66-162*i*1	C59 II	—	14.5	3.56 ± 0.36		cf. 49-115*i*2		
					$Dy^{163}(n, p)\ Tb^{163}$			
66-163*b*1	W60 I	7 ± 1 min*	14.8 ± 0.8	3 ± 1		cf. 13-27*b*4		Element, purity 98% thickness 80 mg/cm^2. Dy^{163} enriched 74%; thickness 35 mg/cm
					$Dy^{164}(n, \alpha)\ Gd^{161}$			
66-164*i*1	W60 I	3.7 ± 0.3 min*	14.8 ± 0.8	4.5 ± 0.8		cf. 27-59*a*1*g*		cf. 66-163*b*1

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

HOLMIUM

$Ho^{165}(n, 2n)\, Ho^{164}$

67-165*a*1	K61 II	38.5 min	14.8 ± 0.5	2100 ± 210		cf. 17-35*a*5*m*		

$Ho^{165}(n, p)\, Dy^{165g}$

67-165*b*1*g*	F61 II	—	14.1 ± 0.2	40 ± 10		cf. 13-27*b*11		

$Ho^{165}(n, p)\, Dy^{165m}$

67-165*b*1*m*	F61 II	—	14.1 ± 0.2	< 1		cf. 13-27*b*11		

I	II	III	IV	V	VI	VII	VIII	IX
					ERBIUM			
					$Er^{166}(n, 2n)\ Er^{165}$			
68-166*a*1	W60 I	10 ± 1*h**	14.8 ± 0.8	1000 ± 400		cf. 27-59*a*1*g*		Element, purity > 98 %; thickness 50-180mg/cm²; Er_2O_3 enriched Er^{168}: 76.9%; Er^{172}: 87.3%; thickness 35 mg/cm²
					$Er^{167}(n, p)\ Ho^{167}$			
68-167*b*1	W60 I	3.1 ± 0.1*h**	14.8 ± 0.8	3 ± 1		cf. 27-59*a*1*g*		cf. 68-166*a*1
					$Er^{168}(n, p)\ Ho^{168}$			
68-168*b*1	W60 I	3.3 ± 0.5 min*	14.8 ± 0.8	2.5 ± 1		cf. 27-59*a*1*g*		cf. 68-166*a*1
					$Er^{168}(n, \alpha)\ Dy^{165g}$			
68-168*i*1*g*	W60 I	140 ± 5 min*	14.8 ± 0.8	0.5 ± 0.2		cf. 27-59*a*1*g*		cf. 68-166*a*1
					$Er^{168}(n, \alpha)\ Dy^{165m}$			
68-168*i*1*m*	W60 I	1.3 ± 0.2 min*	14.8 ± 0.8	1 ± 0.2		cf. 27-59*a*1*g*		cf. 68-166*a*1
					$Er^{170}(n, 2n)\ Er^{169}$			
68-170*a*1	W60 I	9.8 ± 0.5*d**	14.8 ± 0.8	1200 ± 500		cf. 27-59*a*1*g*		cf. 68-166*a*1
					$Er^{170}(n, p)\ Ho^{170}$			
68-170*b*1	W60 I	40 ± 10 sec*	14.8 ± 0.8	1.8 ± 0.5		cf. 27-59*a*1*g*		cf. 68-166*a*1
					$Er^{170}(n, \alpha)\ Dy^{167}$			
68-170*i*1	W60 I	4.4 ± 0.4 min*	14.8 ± 0.8	1.0 ± 0.2		cf. 27-59*a*1*g*		cf. 68-166*a*1

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

YTTERBIUM

$Yb^{176}(n, 2n)\,Yb^{175}$

I	II	III	IV	V	VI	VII	VIII	IX
70-176*a*1	W60 I	4.2 ± 0.2*d**	14.8 ± 0.8	430 ± 100		cf. 13-27*b*4		Element, thickness 40 mg/cm²
70-176*a*2	K61 II	99*h*	14.8 ± 0.5	786 ± 80		cf. 17-35*a*5*m*		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

LUTETIUM

$Lu^{175}(n, 2n)\ Lu^{174}$

I	II	III	IV	V	VI	VII	VIII	IX
71-175*a*1	W60 I		14.8 ± 0.8	1600 ± 300		cf. 27-59*a*1*g*		

$Lu^{175}(n, p)\ Yb^{175}$

I	II	III	IV	V	VI	VII	VIII	IX
17-175*b*1	C59 II	—	14.5	3 42 ± 0.51		cf. 49-115*i*2		

I	II	III	IV	V	VI	VII	VIII	IX

HAFNIUM

$Hf^{178}(n, \alpha)\ Yb^{175}$

72-178*i*1	C59 II	—	14.5	2.0 ± 0.2		cf. 49-115*i*2		

TANTALUM

I	II	III	IV	V	VI	VII	VIII	IX
				$Ta^{181}(n, 2n) Ta^{180}$ - tot.				
73-181*a1t*	A58 II	—	14.1	2640 ± 200		cf. 1-2*a*1		Element
73-181*a2t* diff.	R57	—	14.1	1800 ± 300 for $E_n > 0.5$ MeV; $d\Omega = 4\pi$		cf. 4-9*a*2		
				$Ta^{181}(n, 2n) Ta^{180m}$				
73-181*a*1*m*	P61 I	8.15*h*	13.88 ± 0.10* 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26	1118 ± 56 1132 ± 56 1115 ± 56 1116 ± 56 1087 ± 55		cf. 22-46*a*2		
73-181*a*2*m*	P53	8*h*	14.5 ± 0.35	867 ± 220		cf. 7-14*a*1		Element
73-181*a*3*m*	P60 II	8*h*	14.8 ± 0.8	2740 ± 30		cf. 50-120*b*1		
				$Ta^{181}(n, p) Hf^{181}$				
73-181*b*1	S59 IV	—	14	2.5 ± 0.3	—	—	—	—

* Also measured for 12.1 MeV $\leq E_n \leq$ 19.8 MeV

TUNGSTEN

I	II	III	IV	V	VI	VII	VIII	IX
					$W^{182}(n, p)\ Ta^{182}$			
74-182*b*1	S59 IV	—	14	2.3 ± 0.2	—	—	—	—
					$W^{183}(n, p)\ Ta^{183}$			
74-183*b*1	S59 IV	—	14	2.8 ± 0.3	—	—	—	—
					$W^{184}(n, p)\ Ta^{184}$			
74-184*b*1	C59 II	—	14.5	4.75 ± 0.95		cf. 49-115*i*2		
74-184*b*2	P61 IV	—	14.8	14 ± 4	—	—	—	—
					$W^{186}(n, p)\ Ta^{186}$			
74-186*b*1	C59 II	—	14.5	2.9 ± 0.6		cf. 49-115*i*2		
74-186*b*2	P61 IV	—	14.8	11 ± 4	—	—	—	—
74-186*b*3	B59 II	—	13.7 ± 0.25* 14.5 ± 0.3 14.85 ± 0.15	1.0 ± 0.2 1.4 ± 0.3 2.8 ± 0.5		cf. 52-128*e*1		
					$W^{186}(n, pn)\ Ta^{185} + W^{186}(n, np + n, d)\ Ta^{185}$			
74-186*c*1	B59 II	—	13.7 ± 0.25* 14.5 ± 0.3 14.85 ± 0.15	< 0.04 0.11 ± 0.05 0.3 ± 0.15		cf. 52-128*e*1		

* Also measured for 18.0 MeV $\leq E_n \leq$ 21.2 MeV

I	II	III	IV	V	VI	VII	VIII	IX

RHENIUM

$Re^{187}(n, 2n)\ Re^{186}$

75-187*a*1	K61 II	89.0*h*	14.8 ± 0.5	1675 ± 168		cf. 17-35*a*5*m*		

$Re^{187}(n, p)\ W^{187}$

75-187*b*1	C59 II	—	14.5	3.93 ± 0.4		cf. 49-115*i*2		

$Re^{187}(n, \alpha)\ Ta^{184}$

75-187*i*1	C59 II	—	14.5	0.94 ± 0.14		cf. 49-115*i*2		

I	II	III	IV	V	VI	VII	VIII	IX

OSMIUM

$Os^{190}(n, \alpha) W^{187}$

I	II	III	IV	V	VI	VII	VIII	IX
76-190*i*1	C59 II	—	14.5	0.57 ± 0.09		cf. 49-115*i*2		

I	II	III	IV	V	VI	VII	VIII	IX

IRIDIUM

$Ir^{191}(n, 2n)\ Ir^{190}$

7-191*a*1	K61 II	3.1*h*	14.8 ± 0.5	367 ± 55		cf. 17-35*a*5*m*		

$Ir^{191}(n, \alpha)\ Re^{188}$

77-191*i*1	C59 II	—	14.5	2.43 ± 0.22		cf. 49-115*i*2		

$Ir^{193}(n, p)\ Os^{193}$

77-193*b*1	C59 II	—	14.5	2.7 ± 0.5		cf. 49-115*i*2		

I	II	III	IV	V	VI	VII	VIII	IX

PLATINUM

$Pt^{194}(n, p)\ Ir^{194}$

I	II	III	IV	V	VI	VII	VIII	IX
78-194*b*1	C59 II	—	14.5	3.92 ± 0.4		cf. 49-115*i*2		

$Pt^{194}(n, \alpha)\ Os^{191}$

I	II	III	IV	V	VI	VII	VIII	IX
78-194*i*1	C59 II	—	14.5	1.26 ± 0.25		cf. 49-115*i*2		

$Pt^{195}(n, p)\ Ir^{195}$

I	II	III	IV	V	VI	VII	VIII	IX
78-195*b*1	C59 II	—	14.5	2.91 ± 0.3		cf. 49-115*i*2		

$Pt^{196}(n, \alpha)\ Os^{193}$

I	II	III	IV	V	VI	VII	VIII	IX
78-196*i*1	C59 II	—	14.5	0.55 ± 0.11		cf. 49-115*i*2		

$Pt^{198}(n, 2n)\ Pt^{197}$

I	II	III	IV	V	VI	VII	VIII	IX
78-198*a*1	P53	—	14.5 ± 0.35	2770 ± 1500		cf. 7-14*a*1		Element

I	II	III	IV	V	VI	VII	VIII	IX

GOLD

$Au^{197}(n, 2n) Au^{196}$ - tot.

79-197*a*1*t*	P53	5.5*d*	14.5 ± 0.35	1722 ± 460		cf. 7-14*a*1		Element
79-197*a*2*t*	A58 II	—	14.1	2600 ± 200		cf. 1-2*a*1		Element
79-197*a*3*t*	T60	—	13.9[*1]	1960	—	—	—	—
			14.0	1900				
			14.1	2110				
			14.6	2090				
			15.1	2110				
79-197*a*4*t*	P61 I	6.06*d*[*3]	14.01 ± 0.10[*2]	2403 ± 120	cf. 22-46*a*2	cf. 79-197*a*1*m*	cf. 22-46*a*2	
			14.31 ± 0.13	2420 ± 120				
			14.50 ± 0.20	2403 ± 120				
			14.81 ± 0.31	2356 ± 120				

$Au^{197}(n, 2n) Au^{196m}$

79-197*a*1*m*	P61 I	9.83*h*	14.01 ± 0.10[*2]	134.3 ± 6.7	cf. 22-46*a*2	γ-activity ; calibrated NaI crystal	cf. 22-46*a*2	
			14.31 ± 0.13	137.1 ± 6.9				
			14.50 ± 0.20	142.1 ± 7.1				
			14.81 ± 0.31	145.1 ± 7.3				
79-197*a*2*m*	T60	—	13.9[*4]	165	—	—	—	—
			14.0	165				
			14.1	195				
			14.6	210				
			15.1	195				

$Au^{197}(n, p) Pt^{197}$

79-197*b*1	C59 II	—	14.5	2.42 ± 0.24		cf. 49-115*i*2		

[*1] Also measured for 8.2 MeV $\leq E_n \leq$ 15.1 MeV
[*2] Also measured for 12.1 MeV $\leq E_n \leq$ 19.8 MeV
[*3] Measured by the authors
[*4] Also measured for 9.4 MeV $\leq E_n \leq$ 15.1 MeV

I	II	III	IV	V	VI	VII	VIII	IX
79-197*b*2	P61 IV	—	14.01 ± 0.10*1	1.8 ± 0.1		cf. 22-46*a*2		
			14.09 ± 0.10	2.0 ± 0.1				
			14.31 ± 0.13	2.0 ± 0.1				
			14.50 ± 0.20	2.2 ± 0.1				
			14.68 ± 0.26	2.6 ± 0.1				
			14.81 ± 0.31	2.4 ± 0.1				
			14.93 ± 0.36	2.6 ± 0.1				
				$Au^{197}(n, He^3)\ Ir^{195}$				
79-197*f*1	B62 II		14.7	< 0.020	—	—	—	—
				$Au^{197}(n, \alpha)\ Ir^{194}$				
79-197*i*1	P61 IV	—	14.01 ± 0.10*2	0.27 ± 0.02		cf. 22-46*a*2		
			14.09 ± 0.10	0.27 ± 0.02				
			14.31 ± 0.13	0.28 ± 0.02				
			14.50 ± 0.20	0.35 ± 0.02				
			14.68 ± 0.26	0.38 ± 0.02				
			14.81 ± 0.31	0.46 ± 0.02				
			14.93 ± 0.36	0.44 ± 0.02				
79-197*i*2	C59 II	—	14.5	0.43 ± 0.04		cf. 49-115*i*2		
				$Au^{197}(n, n\alpha)\ Ir^{193}$				
79-197*k*1	B62 II	12*d*	14.7	< 1.5	—	—	—	—

*1 Also measured for 12.1 MeV $\leq E_n \leq$ 19.6 MeV
*2 Also measured for 7 MeV and 12.1 MeV $\leq E_n \leq$ 19.8 MeV

I	II	III	IV	V	VI	VII	VIII	IX
					MERCURY			
					$Hg^{200}(n, p)\ Au^{200}$			
80-200*b*1	C59 II	—	14.5	3.63 ± 0.36		cf. 49-115*i*2		
					$Hg^{200}(n, \alpha)\ Pt^{197}$			
80-200*i*1	C59 II	—	14.5	1.77 ± 0.35		cf. 49-115*i*2		
					$Hg^{201}(n, p)\ Au^{201}$			
80-201*b*1	C59 II	—	14.5	2.12 ± 0.32		cf. 49-115*i*2		
					$Hg^{202}(n, \alpha)\ Pt^{199}$			
80-202*i*1	C59 II	—	14.5	1.01 ± 0.10		cf. 49-115*i*2		

THALLIUM

$Tl^{203}(n, 2n)\,Tl^{202}$

I	II	III	IV	V	VI	VII	VIII	IX
81-203*a*1	P61 I	12.5*d*	13.88 ± 0.10*[1]	1302 ± 58		cf. 22-46*a*2		
			14.09 ± 0.10	1302 ± 58				
			14.31 ± 0.13	1329 ± 60				
			14.50 ± 0.20	1321 ± 60				
			14.68 ± 0.26	1305 ± 58				
81-203*a*2	T60	—	13.9*[2]	1450	—	—	—	—
			14.0	1460				
			14.6	1560				
			15.1	1650				
81-203*a*3	M52		Rel. measurement*[3]			cf. 19-63*a*12		

$Tl^{203}(n, p)\,Hg^{203}$

I	II	III	IV	V	VI	VII	VIII	IX
81-203*b*1	P61 IV	—	14.8	30	—	—	—	—

$Tl^{203}(n, \alpha)\,Au^{200}$

I	II	III	IV	V	VI	VII	VIII	IX
81-203*i*1	C59 II	—	14.5	0.37 ± 0.04		cf. 49-115*i*2		

$Tl^{203}(n, n\alpha)\,Au^{199}$

I	II	III	IV	V	VI	VII	VIII	IX
81-203*k*1	B62 II	3.15*d*	14.7	< 0.012	—	—	—	—

$Tl^{205}(n, p)\,Hg^{205}$

I	II	III	IV	V	VI	VII	VIII	IX
81-205*b*1	P53	6 min	14.5 ± 0.35	3.05 ± 0.6		cf. 7-14*a*1		Element
81-205*b*2	C59 II	—	14.5	6.8 ± 0.7		cf. 49-115*i*2		
81-205*b*3	P61 IV	—	14.8	3.0 ± 0.3	—	—	—	—

$Tl^{205}(n, He^3)\,Au^{203}$

I	II	III	IV	V	VI	VII	VIII	IX
81-205*f*1	B62 II	55 sec	14.7	< 0.010	—	—	—	—

*[1] Also measured for 12.3 MeV $\leq E_n \leq$ 19.8 MeV
*[2] Also measured for 8.4 MeV $\leq E_n \leq$ 15.1 MeV
*[3] Also measured for 12 MeV $\leq E_n \leq$ 18.5 MeV

I	II	III	IV	V	VI	VII	VIII	IX

LEAD

$Pb^{208}(n, 2n) Pb^{207m}$

I	II	III	IV	V	VI	VII	VIII	IX
82-208*a*1*m*	G61 I	0.81 ± 0.02 sec*	14.5	1700 ± 300	rel. : cf. 29-63*a* $Cu^{63}(n, 2n)$ = 620 mb	cf. 12-24*b*1*m*		

$Pb^{208}(n, p) Tl^{208}$

I	II	III	IV	V	VI	VII	VIII	IX
82-208*b*1	P53	3.1 min	14.5 ± 0.35	0.96 ± 0.96		cf. 7-14*a*1		Element

$Pb^{208}(n, \alpha) Hg^{205}$

I	II	III	IV	V	VI	VII	VIII	IX
82-208*i*1	C59 II	—	14.5	1.58 ± 0.27		cf. 49-115*i*2		

$Pb^{nat}(n, 2n) Pb$

I	II	III	IV	V	VI	VII	VIII	IX
82-*a*1	A58 II	—	14.1	2740 ± 200		cf. 1-2*a*1		Element

* Measured by the authors

BISMUTH

$Bi^{209}(n, 2n)\,Bi^{208}$ - tot.

I	II	III	IV	V	VI	VII	VIII	IX
83-209*a*1*t*	A58 II	—	14.1	2600 ± 200		cf. 1-2*a*1		Element
83-209*a*2*t*	R57	—	14.1	2300 ± 300 for $E_n > 0.5$ MeV : $d\Omega = 4\pi$ $Bi^{209}(n.2n)Bi^{208m}$		cf. 4-9*a*2		
83-209*a*1*m*	G61 I	2.6 ± 0.1 msec*	14.5	660 ± 120	rel. : cf. 29-63*a* $Cu^{63}(n, 2n)$ 620 mb	cf. 12-24*b*1*m*		

$Bi^{209}(n, p)\,Pb^{209}$

I	II	III	IV	V	VI	VII	VIII	IX
83-209*b*1	P59 I	3.31 ± 0.03*h**	14.8 ± 0.8	0.83 ± 0.40		cf. 13-27*b*4		Element, thickness 34-56 mg/cm²
83-209*b*2	C59 II	—	14.5	1.33 ± 0.26		cf. 49-115*i*2		
83-209*b*3	M61 II	—	14.8	0.7 ± 0.1		cf. 11-23*i*2		

$Bi^{209}(n, \alpha)\,Tl^{206}$

I	II	III	IV	V	VI	VII	VIII	IX
83-209*i*1	P53	4 min	14.5 ± 0.35	1.2 ± 1.0		cf. 7-14*a*1		Bi_2O_3 ; Element
83-209*i*2	P59 I	4.29 ± 0.05 min*	14.8 ± 0.8	1.1 ± 0.3		cf 13-27*b*4		Element, discs, thickness 34-56 mg/cm²
83-209*i*3	C59 II	—	14.5	0.52 ± 0.08		cf. 49-115*i*2		
83-209*i*4	M61 II	—	14.8	0.6 ± 0.1		cf. 11-23*i*2		

* Measured by the authors

I	II	III	IV	V	VI	VII	VIII	IX

THORIUM

$Th^{230}(n, \alpha) Ra^{227}$

I	II	III	IV	V	VI	VII	VIII	IX
90-230*i*1	C59 II	—	14.5	4.5 ± 1.1	rel. : $Al^{27}(n, \alpha)$ = ?	β-activity, 2π geometry; prop. counter; chem. separation. Calibration by measurements in 4π geometry	Mean error contains: statistics, neutron flux chem. separation	—

$Th^{232}(n, 2n) Th^{231}$

I	II	III	IV	V	VI	VII	VIII	IX
90-232*a*1	P61 I	26.64*h*	13.88 ± 0.10*1 14.09 ± 0.10 14.31 ± 0.13 14.50 ± 0.20 14.68 ± 0.26 14.81 ± 0.31 14.93 ± 0.36	1580 ± 158 1560 ± 156 1520 ± 152 1440 ± 144 1400 ± 140 1280 ± 128 1255 ± 125		cf. 22-46*a*2		
90-232*a*2	T60	—	13.9*2 14.0 14.6 15.1	1490 1330 1400 980	—	—	—	—
90-232*a*3	Z61	—	14.7	650 ± 150	rel. : σ(U^{238}fiss.) = 1.16	β-activity, 4π geometry. Chem. separation	Error contains: σ(U^{238} fiss.); statistics	$Th(NO_3)_4 \cdot 4H_2O$
90-232*a*4	D59 VII	—	14.45 ± 0.20	1230 ± 60	rel. : cf. 16-32*b*2 $S^{32}(n, p)$ = 229 mb Sandwich method	β-activity; chem. separation	Error contains: statistics; calibration	Metal discs of 3/16″ ⌀ and 0.040″ thickness
90-232*a*5	P61 VIII	—	14.5 ± 0.5	1200 ± 50	rel. : cf. 13-27*i* $Al^{27}(n, \alpha)$ = ?	γ-activity 2 ½″ × 2 ½″ NaI crystal. Calibration with standard sources	Error contains: statistics 1 %; calibration 3 %; neutron flux 3 %; weight of the target 1 %	Oxyd, 2 cm^2, 8.35 mg/cm^2

*1 Also measured for 12.2 MeV $\leq E_n \leq$ 16.5 MeV
*2 Also measured for 8.2 MeV $\leq E_n \leq$ 15.1 MeV

I	II	III	IV	V	VI	VII	VIII	IX

URANIUM

$U^{235}(n, p)\ Pa^{235}$

I	II	III	IV	V	VI	VII	VIII	IX
92-235*b*1	C59 II	—	14.5	1.86 ± 0.37		cf. 20-230*i*1		

$U^{238}(n, 2n)\ U^{237}$

I	II	III	IV	V	VI	VII	VIII	IX
92-238*a*1	P61 VIII	—	14.5 ± 0.4	690 ± 40	rel. : cf. 29-65*a* $Cu^{65}(n, 2n)$ = ?	cf. 90-232*a*5	Error contains : neutron flux 5 % ; thick source correction 2 % ; weight of the targ. 1 % ; calibration 2 %	Oxyd 275 mg

$U^{238}(n, \alpha)\ Th^{235}$

I	II	III	IV	V	VI	VII	VIII	IX
92-238*i*1	C59 II	—	14.5	1.5 ± 0.3		cf. 90-230*i*1		

I	II	III	IV	V	VI	VII	VIII	IX

NEPTUNIUM

$Np^{237}(n, 2n)\ Np^{236}$

I	II	III	IV	V	VI	VII	VIII	IX
93-237*a*1	P61 VIII	2.7 ± 0.3*y*	14.5 ± 0.4	390 ± 40	—	Counting of the α of Pu^{236}	—	Dioxyde 72 mg

$Np^{237}(n, p)\ U^{237}$

I	II	III	IV	V	VI	VII	VIII	IX
93-237*b*1	C59 II	—	14.5	1.3 ± 0.3		cf. 90-230*i*1		

I	II	III	IV	V	VI	VII	VIII	IX

PLUTONIUM

$Pu^{239}(n, p)\ Np^{239}$

I	II	III	IV	V	VI	VII	VIII	IX
94-239*b*1	C59 II	—	14.5	3.0 ± 0.5		cf 90-230*i*1		

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